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A DIRECT COMPARISON OF REENTRY F HEAT-TRANSFER-RATE DATA TO GROUND FACILITY MEASUREMENTS (U)

David E. Boylan
ARO, Inc.

VON KÁRMÁN GAS DYNAMICS FACILITY
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Prepared for

ARNOLD ENGINEERING DEVELOPMENT CENTER (DY)
ARNOLD AIR FORCE STATION, TENNESSEE 37389

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NOTICES

APPROVAL STATEMENT

This technical report has been reviewed and is approved for publication.

FOR THE COMMANDER

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Correlation parameters are developed to compare ground test facility surface heating-rate data on non-ablating sharp slender cones directly to data obtained during a full-scale hypersonic reentry flight. Surface data under laminar and fully developed turbulent boundary layers are compared. The problem of failure to fully simulate local Mach number, Reynolds number, and boundary-layer temperatures is shown to be of secondary importance.

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20. ABSTRACT (Continued)

Sufficient information is provided to allow the reader to add additional experimental results. (U)

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PREFACE

(U) The research reported herein was conducted at the Arnold Engineering Development Center (AEDC), Air Force Systems Command (AFSC), under Program Element 65802F. The results of tests presented were obtained by ARO, Inc. (a subsidiary of Sverdrup & Parcel and Associates, Inc.), contract operator of AEDC, AFSC, Arnold Air Force Station, Tennessee. The research was conducted during FY 73 and 74 under ARO Project No. VF431, and the manuscript (ARO Control No. ARO-VKF-TR-74-61) was submitted for publication on July 18, 1974.

(U) The author would like to acknowledge the work of Dr. W. S. Norman in the original formulation of the correlation parameters utilized herein, the many suggestions of B. J. Griffith during the course of the study, and the programming work of Mrs. Betty Majors.

(U) This report contains classified material (Confidential) extracted from Refs. 2 through 7.

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1.0 INTRODUCTION

(U) The simulation of true reentry flight conditions is generally not possible in present-day ground test facilities due to limitations of temperature, pressure, and size. This, of course, does not prevent the acquisition of useful design information from ground tests. The usual procedure in the design and development of a reentry vehicle is to conduct tests in laboratory facilities where only partial simulation of full-scale flight conditions is possible and then to extrapolate the test data to true flight conditions with the aid of analytic methods. Quite often, the flight configuration is too complex to be amenable to analytic methods and in other cases the final flight vehicle contains significant geometric changes from the model previously tested in ground facilities. The reliance on analytic predictions of flight conditions implicitly assumes that parameters present in the flight regime such as surface ablation, mass addition in the boundary layer, vehicle distortion, nonuniform wall heating, and real-gas effects can be analytically determined or shown to be of second-order importance. While these effects are not impossible to duplicate in a ground facility, they seldom are attempted due to the increased cost of a test program and poorly defined test objectives prior to a flight test.

(U) Discrepancies between preflight predictions and full-scale flight results are normally traceable to deficiencies in one of the afore-mentioned areas when surface heating rates are being analyzed. Often, postflight ground tests are conducted which examine areas previously believed to be of second-order importance with resulting clarification of flight data. Although such information is useful for future RV design, this is of little use to flight vehicle designers as far as that particular vehicle is concerned.

(U) An effort is made at Arnold Engineering Development Center (AEDC) to examine full-scale flight results along with applicable preflight or postflight ground facility data. The overall aim of the project is to arrive at recommendations for improved ground facility techniques and approaches. Emphasis is rather naturally placed on examining data obtained at AEDC. Areas of interest include aerodynamic force and stability data, the effects of ablation and mass addition in the boundary layer, and local surface heat-transfer rate and pressure measurements. The flight regime studied in the von Kármán Gas Dynamics Facility (VKF) is usually hypersonic with fully laminar, transitional, and turbulent boundary-layer test results being examined. The problem of location and prediction of the onset of boundary-layer transition has been the subject of numerous studies and is not one of the questions considered in the present research project.

(U) This report presents a correlation method which allows a direct comparison between ground facility surface heat-transfer-rate data obtained on nonablating sharp, zero-lift, slender cone configurations with both laminar and turbulent boundary layers

to some recent full-scale flight results obtained specifically for comparison to analytic and empirical prediction methods. Treatment of data of this type, and in this manner, is of course not new or unique. A very valid statement has been made (Ref. 1) that correlations do not improve with age. As the band of applicable data broadens, subparameters emerge and correlations become fuzzier. Correlations should never be applied out of their stated band of applicability and should be constantly reviewed as new information becomes available. This latter requirement is seldom possible for a reader of a correlation method because sufficient information is invariably lacking to perform the mechanics of the correlation. The present report includes sufficient information to perform the necessary calculations. The formulator of a correlation method has no control over its misuse by the reader. However, he does have the responsibility of defining, as well as possible, the "known" limits of application of the method.

(U) The present correlation attempted to follow the following general guidelines:

1. The correlation should be useful for design calculations. The often-used virtual origin taken as the location of transition or peak heating is, therefore, avoided.

2. Input information necessary such as local flow conditions and temperatures can be represented by first-order theories. That is, real-gas effects, entropy swallowing, etc., were implicitly assumed to not affect the heating data and both the ground test and flight data could then be manipulated in the same consistent manner. The accuracy of this procedure can only be measured in the degree of success of the final solution.

3. The ground test data must be generated in several different hypersonic facilities and follow certain constraints which are discussed later. Emphasis is placed on data generated in the several AEDC-VKF hypersonic tunnels.

4. Sufficient information should be given so that other experimentalists, with data not available to the author, can add to (and improve) the present correlation.

2.0 FLIGHT DATA

(U) Ground test facility engineers have two basic problems when an analysis of flight and ground test results is attempted. First, flight test results are severely restricted in distribution and, second, flight vehicles are seldom instrumented with surface sensors to the degree necessary to perform more than a cursory comparison between preflight ground test data and actual flight results. There are exceptions to these and one such flight test provides the basis of the present study.

(~~C~~) The NASA-sponsored Reentry F flight vehicle was flown on April 27, 1968 from Wallops Station, Virginia (Ref. 2). Since an excellent documentation of the Reentry F flight has been accomplished, the present report will not reproduce it except so far as is necessary. Reentry heating data are discussed in detail in Ref. 2, as well as complementary information required to analyze the data.

(~~C~~) The flight vehicle was a 5-deg half-angle, 13-ft-long cone with an initial nose radius of 0.10 in. To limit the bluntness effects of the nose tip on the reentry conical flow conditions, the nose material was ATJ graphite. The primary test body of the spacecraft was a beryllium calorimeter conical shell instrumented with thermocouples and pressure ports. The vehicle was launched on a modified Scout booster to a maximum altitude of 634,540 feet and, upon reentry, telemetry was lost at 39,174 feet. The purpose of the experiment was to obtain turbulent-heating and boundary-layer-transition data for local Mach numbers near 15 and local Reynolds number in excess of 200 x 10^6. Care was taken to ensure that the test and environmental data would be of high quality and would be as free as possible from complicating factors such as pressure gradients, ablation and mass addition, real-gas, and angle-of-attack effects. As stated in Ref. 2, these flight heat-transfer-rate data can be used to assess current turbulent-heating and transition methods and, if necessary, aid in the development of new methods in the interest of establishing a high level of confidence in the convective-heating design of advanced vehicles.

(~~C~~) A sketch of the test vehicle indicating location of thermocouple instrumentation is shown in Fig. 1. Flight and vehicle parameters necessary for the present analysis are shown graphically in Fig. 2. Heating data were obtained in the altitude range from 138,000 ft down to 45,000 ft with the primary data period ending at 60,000 ft. At altitudes below 87,000 ft, the spacecraft was distorted to make the primary ray ($\phi = 0°$) and the fourth ray ($\phi = 270°$) concave. The forward portion of the spacecraft distorted much more than the rear portion, and most of the distortion was in the angle-of-attack plane. The variations of nose ablation with time shown in Fig. 2 were calculated using recession rates due to thermochemical oxidation, mechanical erosion ablation using correlated data from ground tests, and a "worst case" computed because of an anomalous rise in the forward nose tip temperature which occurred at about 60,000 ft. It is not believed that the worst case represented the actual nose tip recession because it would have resulted in rapid nose tip destruction, which would have been detected by other instrumentation. Telemetry was lost at 39,174 ft. Heating data became increasingly sensitive to thermal distortion, nose bluntness changes, and angle-of-attack effects at altitudes below 60,000 ft. For the higher altitudes, the boundary layer was laminar with transition first seen at about 100,000 ft and being fully turbulent over the aft half of the vehicle at about 60,000 ft (Ref. 3).

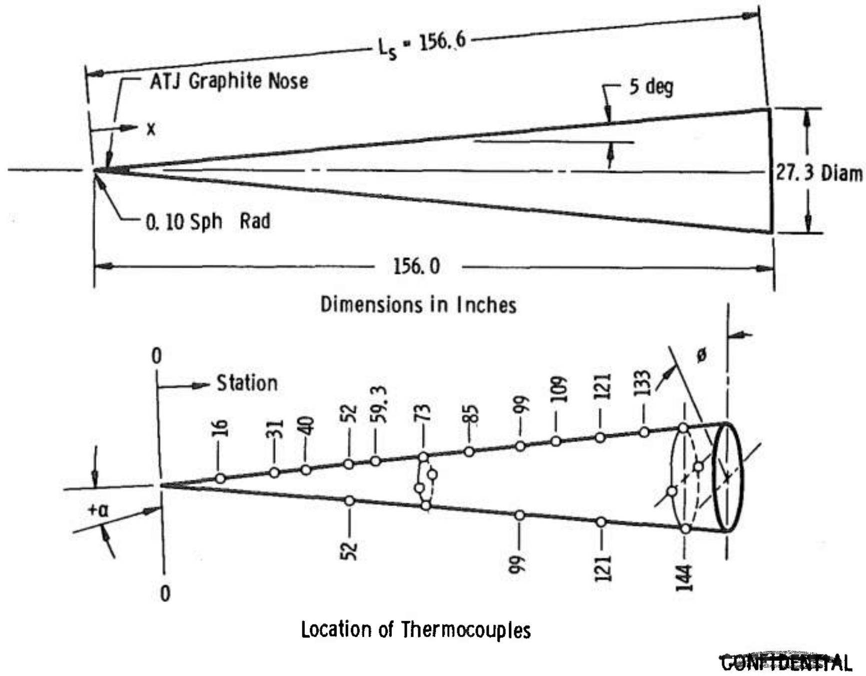


Figure 1. Reentry F flight vehicle.

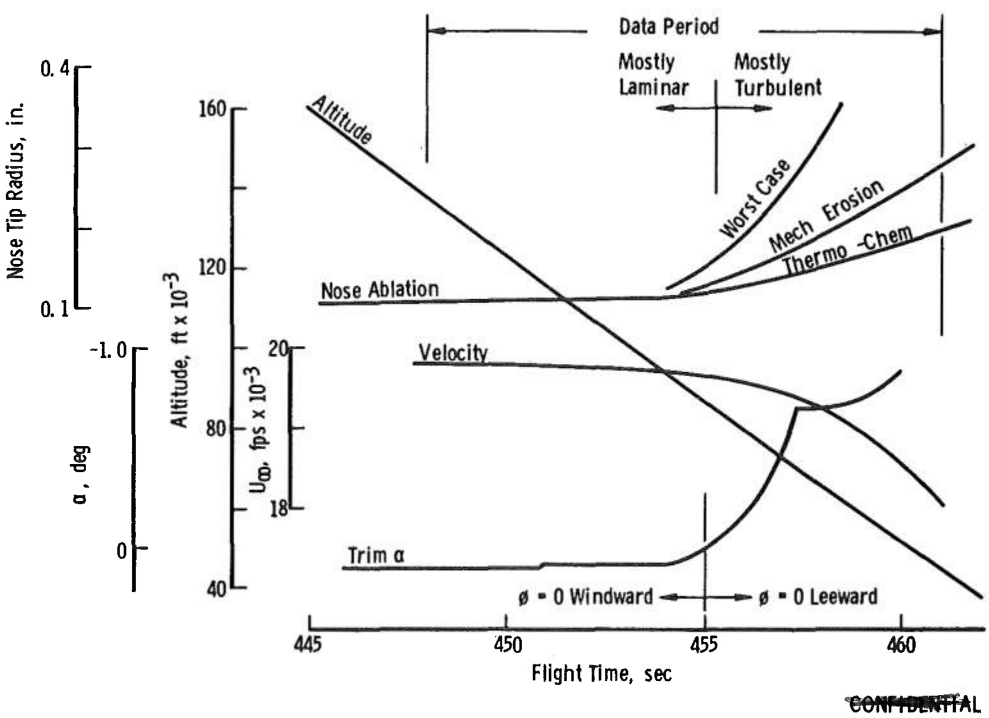


Figure 2. Reentry F flight parameters.

(~~C~~) Although the trim angle of attack was very small (Fig. 2), a rather strong influence on both the onset of transition and the magnitude of transitional and turbulent-heating data could be seen (Ref. 3). A typical data plot of surface heat-transfer rate as a function of vehicle location is shown in Fig. 3. These data were obtained by cross-plotting the results of Ref. 2. The present study does not attempt to correlate or predict the onset of transition or consider transitional data per se. Except for the data shown in Fig. 3, only laminar or fully turbulent data are presented herein. The term fully turbulent is defined graphically in Fig. 3. By selecting data significantly far downstream of the location of peak heating, it is believed that the compressible Reynolds number* based on distance from peak heating was sufficiently large to reduce some of the data scatter oftentimes seen in turbulent heating data.

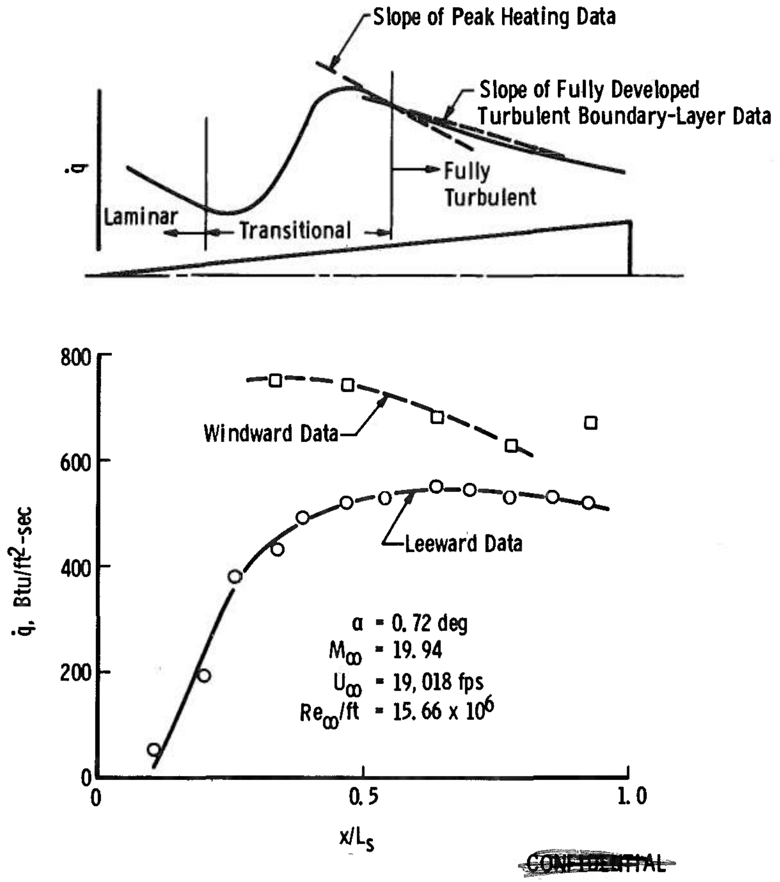


Figure 3. Reentry F surface heating data at 60,000 ft.

*Compressible Reynolds number = $\rho_\infty U_\infty L/\mu_\infty$, $\rho_e U_e L/\mu_e$, etc.

(C) In summary, the Reentry F flight represents the most successful reentry experiment to-date in providing basic surface heating and pressure data on a configuration amenable to both theoretical and experimental comparisons. In terms of local flow parameters, the environment during the prime data acquisition period is not duplicative in present ground test facilities other than ballistic ranges. Neither local boundary-layer temperatures, length Reynolds number, or Mach number can be simultaneously duplicated. Hypersonic test facilities are also much too small to test a model the size of most full-scale flight vehicles, which was 13 feet in the case of the Reentry F experiment.

3.0 AVAILABLE ANALYSES OF FLIGHT DATA

(U) Since publication of the basic heating data (Ref. 2), several studies have been published (Refs. 3 through 7) which examine in some detail the Reentry F results.

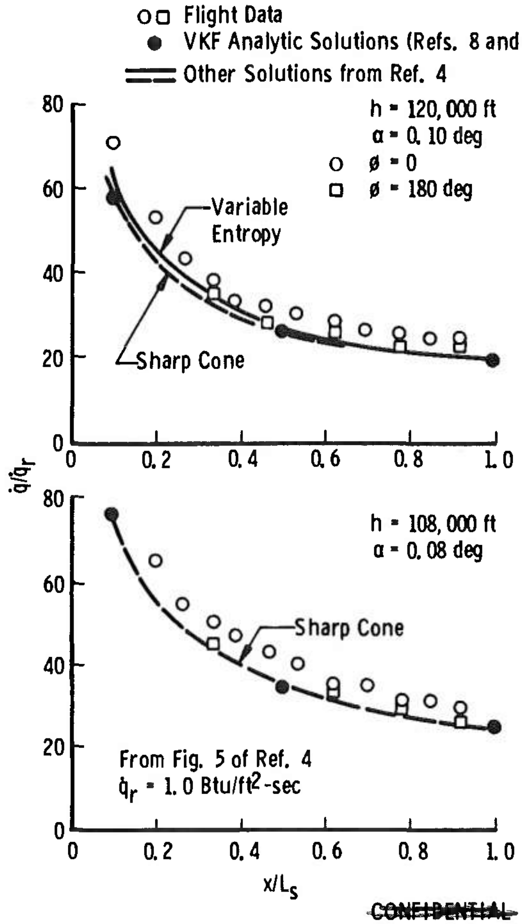
(C) Flight transition locations are discussed by Wright and Zoby (Ref. 3). In addition to the comments noted in Section 2.0, they concluded that the temperature history technique now commonly used for determining transition does not compare favorably with the heating-rate distribution method illustrated in Fig. 3. Some of the confusion present in transition analyses may be due to this problem of interpretation.

(C) Experimental laminar and turbulent heating rates are compared with results from existing flat-plate prediction methods by Zoby and Rumsey (Ref. 4). At conditions of minimal tip blunting and angle of attack, values from a flat-plate laminar method converted to conical flow with Mangler's transformation agreed within 20 percent with the laminar data. The variable entropy technique yields results 10 to 15 percent lower than the data. The Schultz-Grunow skin friction equation with reference enthalpy conditions, Reynolds number based on distance from the transition location and with the Colburn Reynolds analogy, agreed within 10 percent with the experimental turbulent heating data. The Van Driest II skin friction equation, with Reynolds number greater than 10^7 based on distance from the peak heating point and the Colburn Reynolds analogy, was also within approximately 10 percent of the experimental turbulent heating data.

(C) Experimental turbulent heating data were compared to analytic results with characteristic lengths taken as distance from peak heating, transition location, and sharp tip. It was noted that while the root-mean-square error for each set was small, the least spread of the data about their mean line was computed for the Reynolds number based on the distance from the sharp tip. However, for this condition all the flat-plate methods underpredict the experimental Stanton numbers.

(U) The selection of a suitable characteristic length warrants a brief discussion. Zoby and Rumsey (Ref. 4) made a very good point when they indicated that, for design calculations, the major disadvantage of using either distance from beginning of transition or peak heating is that prior knowledge of either location is required. There are presently no satisfactory methods for predicting these locations. The writer has also noted that interpretation of turbulent heat-transfer data can contain large bias errors when these criteria of the virtual origin are used. The adequate development of analytic predictions of transition will no doubt result in much better turbulent correlations. Until that time, the use of the geometric sharp tip is the only recourse if useful results for design purposes are desired.

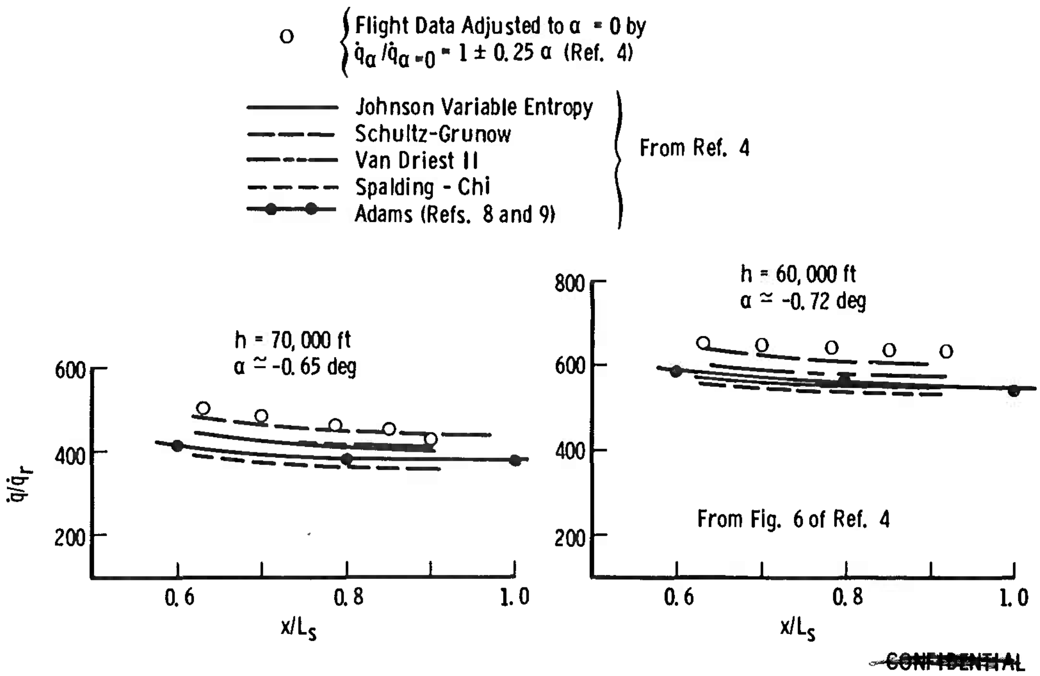
(~~C~~) A direct comparison between flight results and analytic predictions for both laminar and turbulent boundary layers is shown in Fig. 4. With the exception of the



a. Laminar data

Figure 4. Comparison of Reentry F flight data to analytical results.

results of Adams (Refs. 8 and 9), the analytic results shown in Fig. 4 were taken directly from Ref. 4. It should be noted that the analytic predictions shown in Fig. 4b are heat-transfer rates plotted as a function of wetted length and assumes turbulent flow begins at the apex.



b. Turbulent data
Figure 4. Concluded.

(~~C~~) A comprehensive study of the Reentry F turbulent flight data with comparisons to ground facility results is presented by Zoby and Graves (Ref. 5). Turbulent-heating data were compared to the prediction methods of Spalding-Chi, Schultz-Grunow (with Eckert reference enthalpy), and Van Driest II. Reynolds numbers were based on lengths downstream of transition and peak heating locations. In order to obtain data correlation for different free-stream conditions, the data were transformed by several methods to the incompressible values and compared to the respective incompressible relationships. The best overall agreement was obtained with the Spalding-Chi and Schultz-Grunow methods using the modified Colburn Reynolds analogy, with the Reynolds number based on the distance from the peak heating point for the Spalding-Chi method and on the distance from the transition location for the Schultz-Grunow method. The latter method was compared to data transformed by the Eckert reference-enthalpy method. It was noted by the authors that the free-flight data were higher than the ground test data by 15 to 25 percent at comparable incompressible Reynolds numbers and are best predicted

by a different method than that for the ground test data. No reason for the behavior was advanced. Turbulent cone data were transformed to an equivalent flat-plate, zero-degree angle-of-attack value before the incompressible transformation was applied.

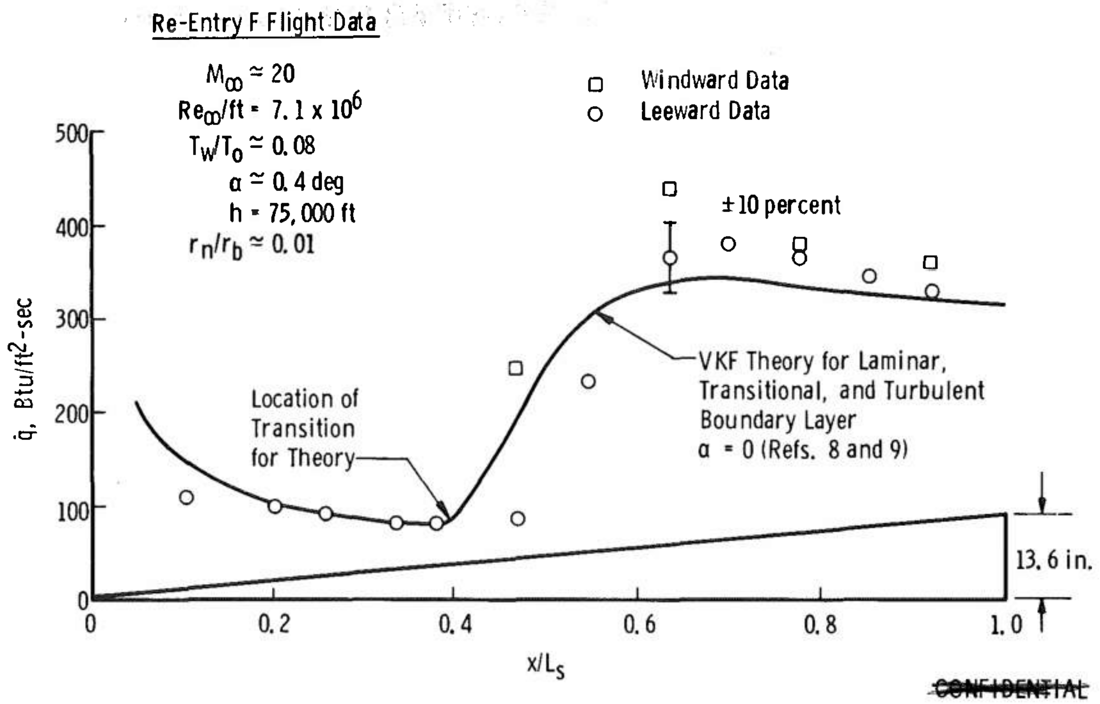
(U) The present approach is very similar to this latter method with the following basic differences:

1. Comparison to analytic approaches is not as comprehensive in the present report.
2. Laminar, as well as turbulent, data are examined.
3. The present method is restricted to only cone data.
4. The characteristic length is taken as the distance from the sharp nose so that the results can be applicable for design or pretest analysis.
5. Boundary-layer-edge conditions are simplified by empirical methods.
6. No second-order or real-gas effects are considered.
7. Final correlations are expressed in terms of compressible Reynolds number for usefulness.

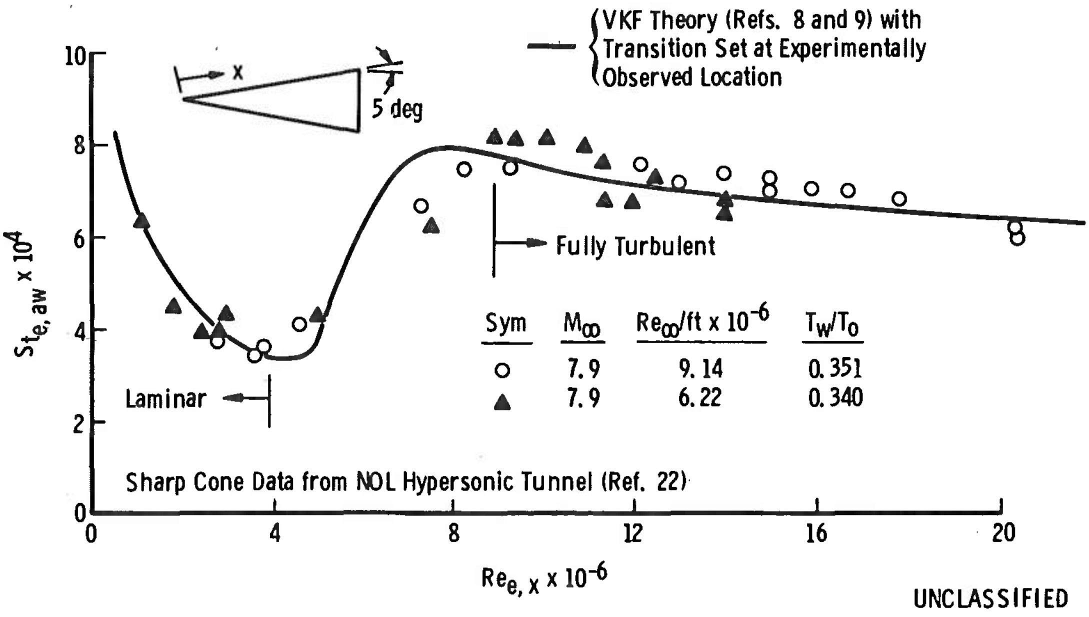
(~~C~~) A similar analysis is reported by Stainback, et al. (Ref. 6). Laminar Reentry F heating rates were compared to a linearized theory for sharp cones at angle of attack and a modified tangent-cone theory while transitional and turbulent-heating rates were compared with predictions from an integral theory which used a modified tangent-cone technique. In addition to comparison of flight to analytic results, comparison is also made between flight and wind tunnel results where the tunnel results were obtained on a scaled Reentry F configuration model including nose details. These tunnel data were produced after the Reentry F flight at $M_\infty \approx 8$ and wall temperature ratio (T_w/T_o) about 0.4. Although tests were conducted on models having several different nose radii, little turbulent data were obtained on models with the larger nose radii (0.10 and 0.096 in.). The results of the investigation indicated that for fully developed turbulent flow the Reentry F nose geometry and a 10-deg roll do not significantly influence the rate of heat transfer to the windward and leeward rays of the Reentry F vehicle. The laminar wind tunnel data indicated that the tangent-cone theory does not provide reliable predictions for leeward heating on slender cones (5-deg half-angle) at angles of attack greater than a few tenths of a degree. The ground facility data presented in Ref. 6 would be directly applicable to the present correlation method. However, the data are presented in a nondimensional form and several flow field properties are left undefined which are necessary in the present method.

(~~C~~) Boundary-layer-edge conditions that account for the effects of the entropy layer were calculated for the Reentry F vehicle and trajectory in Ref. 7. For the Reentry F flight, fully developed turbulent flow occurred with essentially constant boundary-layer-edge conditions near the sharp cone values. In the laminar flow regime, edge conditions (particularly near the model nose) are shown to be dominated by variable entropy effects below 90,000 feet. Above this altitude, at the first thermocouple location, boundary-layer-edge conditions with variable entropy effects were essentially the same as conical flow edge results. Although of possible importance for transition studies, the effect of variable entropy does not appear to be large in laminar analytic predictions for the Reentry F configuration. The laminar flight data presented in the present report represented altitudes equal to or greater than 90,000 feet. It is furthermore a basic assumption in the present study that both the flight and wind-tunnel-edge conditions can be represented by the sharp cone solutions of Jones (Ref. 10) reduced to empirical closed form equations applicable to the bounds of the available data. A discussion of this assumption and comparison with the exact solutions of Ref. 10 are given in Appendix A. As stated earlier, all of the theoretical solutions shown in Fig. 4 are taken directly from and discussed in Ref. 4 with the exception of the boundary-layer solution of Adams (Refs. 8 and 9). This analytic method is used extensively in the present study and warrants some discussion.

(U) The approach used by Adams (Ref. 8) is an adaptation of the intermittency factor description of the transition region proposed by Masaki and Yakura (Ref. 11). The governing boundary-layer equations are numerically integrated using a marching, iterative, implicit, finite-difference method. The turbulent boundary layer is analyzed using a two-layer eddy viscosity model with a constant turbulent Prandtl number, and the transition region is treated through an eddy viscosity-intermittency factor approach. The problem of a sharp cone at incidence was treated in a similar manner (Ref. 9) where it was shown that, in general, smaller cross-flow effects on the windward plane of symmetry boundary layer can be expected for turbulent layers as compared with laminar layers subject to the same boundary conditions. The method makes no claim as to the prediction of transition or the detailed transitional or turbulent boundary-layer structure under hypersonic conditions. It does, however, consider laminar, transitional, and turbulent flow in a single unified analysis based on accurate numerical integration of the governing boundary-layer equations. The numerical results shown in Fig. 4 indicate as good agreement with flight data as the other earlier methods shown. Two additional comparisons are shown in Fig. 5 for flight and ground facility results. The position of transition for each solution must be determined by observation of the data. The selection of the above boundary-layer solution was made because of the availability of a computer code which allows numerous input variables to be studied and the ability to arrive at both laminar and turbulent results with a single unified analysis.



a. Flight data



b. Tunnel data

Figure 5. Additional comparison of VKF boundary-layer solutions with flight and ground facility data.

4.0 DERIVATION OF CORRELATION PARAMETERS

(U) Boundary-layer analysis and local heat-transfer rates on reentry vehicles are dependent on inviscid boundary-layer-edge conditions. The complete simulation of flight local edge conditions and boundary-layer temperature distributions is not possible in ground facilities. This results in one of two approaches being used in any comparison between free-flight and ground data. First, if it can be shown that good comparison between analytic results and ground test results can be obtained, the analytic prediction may be extrapolated to flight conditions. This approach assumes that parameters present in the flight regime such as ablation effects, mass addition in the boundary layer, vehicle distortion, nonuniform wall heating and real-gas effects can be either duplicated in the wind tunnel or shown to be of second-order importance in flight.

(U) The second approach is to develop correlation parameters based on an adequate analytic approach which will effectively represent the local flow field at all conditions for which data are available. The correlation can then hopefully be extrapolated to flight conditions to obtain preflight predictions. Alternately, or additionally, flight data may be correlated by the same method. Ideally, the results could then be used for future design purposes for "similar" conditions. As discussed in the introduction, all correlations should attempt to define their limits of applicability and all users of such correlations should beware of exceeding these limits.

(U) The present correlation parameter is based on a reference enthalpy approach which is basically empirical in nature. It should be noted that the final, closed-form equations are obtained from a correlation of the boundary-layer analysis of Adams (Refs. 8 and 9) and they are, therefore, not empirical but should be considered as an engineering approximation.

4.1 LAMINAR BOUNDARY LAYERS

(U) The Eckert reference enthalpy method for laminar skin friction to a flat plate as given by Hayes and Probstein (Ref. 12) is

$$C_f \propto \left[\frac{\rho^* \mu^*}{\rho_e \mu_e}\right]^n \left[\frac{\mu_e}{\rho_e U_e x}\right]^n \tag{1}$$

where the exponent n is 1/2 for laminar boundary layers.

(U) The relationship between skin friction and heat-transfer rate (Stanton number) is taken as the Colburn modified Reynolds analogy,

$$St_{e,aw} = \frac{Cf}{2} Pr^{-2/3} \quad (2)$$

where $St_{e,aw}$ may also be defined as

$$St_{e,aw} = \dot{q}/\rho_e U_e (H_{aw} - h_w) \quad (3)$$

(U) Combining Eqs. (2) and (3) with Eq. (1) gives the expressions for Stanton number and absolute heat-transfer rate $\dot{q}$:

$$St_{e,aw} \propto \frac{Pr^{-2/3}}{2} \left[\frac{\rho^* \mu^*}{\rho_e \mu_e}\right]^n [Re_{e,x}]^{-n} \quad (4)$$

where

$$Re_{e,x} = \frac{\rho_e U_e x}{\mu_e}$$

and

$$\dot{q} \propto \frac{Pr^{-2/3}}{2} \left[\frac{\rho^* \mu^*}{\rho_e \mu_e}\right]^n [Re_{e,x}]^{-n} \rho_e U_e (H_{aw} - h_w) \quad (5)$$

where the subscript e is used to denote conditions at the outer edge of the boundary layer and μ^* and ρ^* are evaluated at the pressure p_e and a reference enthalpy H^* given by:

$$H^* = 0.5\ (h_w + h_e) + 0.22 \sqrt{Pr}\ U_e^2/2 \quad (6)$$

Using the perfect gas relationships,

$$\frac{H}{RT} = 3.5 \quad (7)$$

and

$$U_e = M_e \sqrt{\gamma R T_e} \quad (8)$$

with

$$R = 1717.6\ ft^2/sec^2\ {}^\circ R,\ \gamma = 1.4,$$

and

$$Pr = 0.71$$

reduces Eq. (6) to:

$$T^* = T_e + 0.5(T_w - T_e) + 0.0370\ T_e\ M_e^2 \tag{9}$$

The adiabatic wall temperature is expressed as

$$T_{aw} = T_o\left[r_f + \frac{T_\infty}{T_o}(1 - r_f)\right] \tag{10}$$

which reduces to

$$T_{aw} = 0.843\ T_o + 0.157\ (T_\infty/T_o) \tag{11}$$

with

$$r_f = \sqrt{Pr} = 0.843 \text{ for air}$$

(U) For a perfect gas, the adiabatic wall enthalpy can be related to temperature by Eq. (7).

4.2 TURBULENT BOUNDARY LAYER

(U) The turbulent boundary-layer theory of Sommer and Short (Ref. 13), as discussed by Wilson (Ref. 14), is used for the development of the present correlation equations. It was pointed out that the results give reasonable agreement for the hypersonic cold wall case and for the adiabatic wall case with poor agreement at intermediate values of wall temperature ratios. Their approach, however, is used herein to develop only correlation parameters written in proportionality form (as Eq. (4)) with the required constants determined from an analytic boundary-layer solution (Refs. 8 and 9).

(U) For a turbulent boundary layer, reference enthalpy is defined differently than for laminar conditions and can be expressed as

$$H^* = h_e + 0.45\ (h_w - h_e) + 0.175\ U_e^2/2 \tag{12}$$

Expressed in terms of temperature, using Eqs. (7) and (8), the result is

$$T^* = T_e + 0.45\ (T_w - T_e) + 0.0348\ T_e M_e^2 \tag{13}$$

This expression is similar to Eq. (9) for laminar boundary layers but does give small numerical differences.

(U) The reference enthalpy approach (in turbulent flow) relates quantities for a compressible flow to those for an incompressible flow. A prime is used to denote the associated incompressible values, defined by:

$$C_f' = \frac{\rho_e}{\rho^*} C_f \tag{14}$$

$$Re_e' = \frac{\rho^*}{\rho_e} \frac{\mu_e}{\mu^*} R_{e_e} = \frac{T_e}{T^*} \frac{\mu_e}{\mu^*} R_{e_e} \tag{15}$$

(U) There are numerous skin friction laws relating skin friction coefficient to Reynolds number. The most convenient form is:

$$C_f' \propto (Re'_{e,x})^{-n} \tag{16}$$

(U) For turbulent conditions the exponent n is not a constant as is the case of laminar boundary layers. Various theoretical solutions are illustrated in Fig. 6. The empirical relationship of Kozlov (Ref. 15) is also included in Fig. 6. Although the resulting absolute

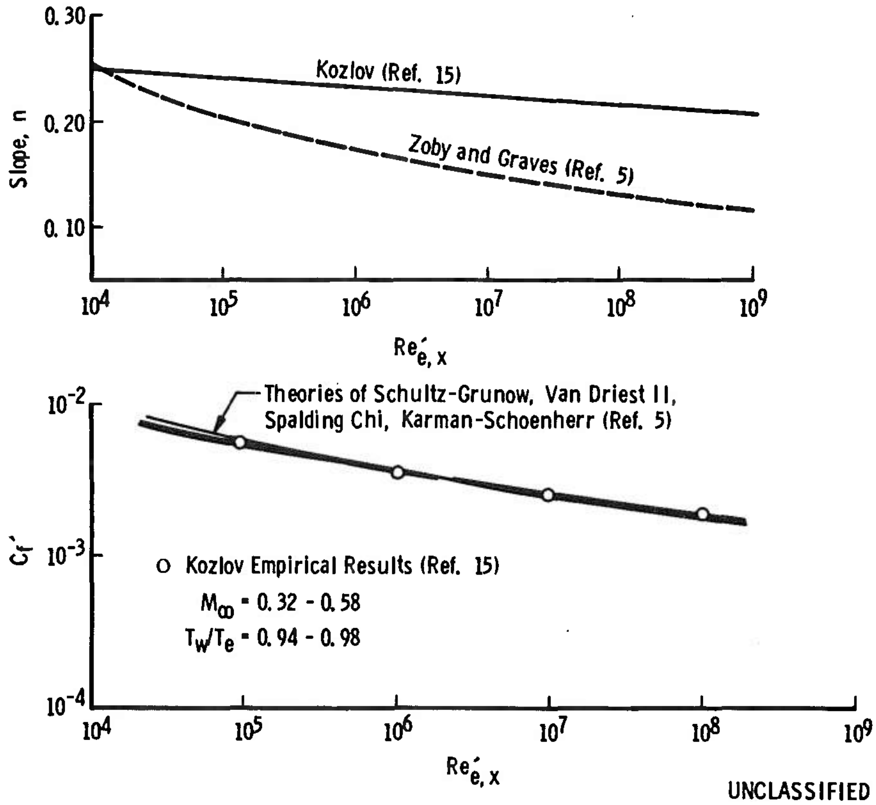


Figure 6. Incompressible local skin friction relations and slopes.

Zoby, Ernest. and Graves, Randolph A., Jr. "Comparison of Results from Three Prediction Methods with Turbulent Heating Data from Wind-Tunnel and Free-Flight Tests (U)." NASA TM X-2390, September 1971. (Confidential)

. Kozlov, L. V. "Experimental Study of Surface Friction on a Plane Plate in a Supersonic Flow with Heat Exchange." APL Translation 945, Applied Physics Laboratory, The John Hopkins University, February 1964.

values of skin friction are very close for all methods shown, the change of skin friction with Reynolds number (slope n of Eq. (16)) is seen to vary significantly. Zolby and Graves (Ref. 5) used an empirical relationship for n as

$$n = \frac{0.8686 \log Re'_{e,x} - 2.435}{(\log Re'_{e,x} - 1.5)(\log Re'_{e,x} - 2.3686)} \tag{17}$$

where the exponent in the Kozlov relationship is:

$$n = -0.29 + 0.01 \log Re'_{e,x} \tag{18}$$

(U) Since the exponent n is a slowly varying function of Reynolds number and almost all turbulent boundary-layer data are obtained over a very limited range of Reynolds number, most investigators select an average value (usually 1/5) as the exponent for analytic solutions and correlation purposes. However, the present study involves data over several orders of magnitude in Reynolds number. This method could, therefore, not be employed. Both the variation of slope proposed by Kozlov and that used by Zoby were tried in the present study. Both variations were adequate with Eq. (17) resulting in correlation with a few percent less scatter. All data presented herein employ Eq. (17) as the variation of slope of the coefficient of skin friction with Reynolds number for turbulent boundary-layer conditions.

Using Eqs. (14) and (15) in Eq. (16) gives:

$$C_f \propto \frac{\rho^*}{\rho_e} \left[\frac{\rho_e \mu^*}{\rho^* \mu_e} \frac{1}{Re_e}\right]^n$$

or

$$C_f \propto \left(\frac{\rho^*}{\rho_e}\right)^{1-2n} \left(\frac{\rho^* \mu^*}{\rho_e \mu_e}\right)^n \left(\frac{1}{Re_e}\right)^n \tag{19}$$

Using the perfect gas relationship between pressure and density* and defining a Chapman Rubesin viscosity ratio as

$$C_e^* = \frac{\mu^*}{\mu_e} \frac{T_e}{T^*} \tag{20}$$

reduces Eq. (19) to

$$C_f \propto \left(\frac{\rho^*}{\rho_e}\right)^{1-2n} (C_e^*)^n \left(\frac{1}{Re_e}\right)^n \tag{21}$$

*Assumes no pressure variation through the boundary layer.

By using the definition of skin friction coefficient and edge Stanton number given in Eqs. (2) and (3), Eq. (21) reduces to:

$$St_{e,aw} = \frac{K_1\ Pr^{-2/3}}{2} \left(\frac{\rho^*}{\rho_e}\right)^{1-2n} (C_e^*)^n \quad (Re_{e,x})^{-n} \tag{22}$$

(U) Equation (22) was derived from turbulent boundary-layer relationships but reduces to the laminar relationship (Eq. (4)) for the case n = 0.5.

(U) The general equation relating local edge Stanton number to local edge Reynolds number is expressed as

$$St_{e,aw}/(\rho^*/\rho_e)^{1-2n} \quad (C_e^*)^n = \frac{K_1}{2\ Pr^{2/3}} \cdot (Re_{e,x})^{-n} \tag{23}$$

where the constant $K_1/2\ Pr^{2/3}$ will have a different numerical value for laminar and turbulent boundary layers and must be determined by some appropriate analytical approach and the exponent n is 1/2 for laminar boundary layers and related to local incompressible edge Reynolds numbers by Eq. (17) for turbulent boundary layers. The Mangler transformation from flat plate to conical flows would also be included in this constant if the analytic solutions utilized are for conical flow conditions. The resulting constant is then expressed as $\sqrt{3}\ K_1/2\ Pr^{2/3}$.

4.3 DETERMINATION OF THE CONSTANT $\sqrt{3}\ K_1/2\ Pr^{2/3}$

(U) In order to determine the constant $\sqrt{3}\ K_1/2\ Pr^{2/3}$ in Eq. (23) a large number of free-stream conditions, cone angles, and wall temperatures were used in a computer code supplied by Adams (Refs. 8 and 9). The resulting analytic predictions of heat-transfer rates were then used to calculate the parameters in Eq. (23). The results for an assumed laminar boundary layer are shown in Fig. 7, while the results of the fully turbulent solutions are shown in Fig. 8. In the formulation and programming of the analytic method, Adams assumed that gas viscosity could be represented by Sutherland's relationship for air. The present method uses these predictions of local heat-transfer rate (for a given free-stream condition and model) and calculates the parameters shown in Figs. 7 and 8). For consistency, it was therefore necessary to utilize Sutherland's viscosity for all solutions shown in these figures. Later calculation of facility data will use viscosity relationships applicable to the temperature range of the various facilities. Details of the present method are included in Appendix A.

(U) The open symbols shown in Fig. 7 are typical of hypersonic wind tunnel conditions and model sizes, while the closed symbols represent typical flight values of free-stream Mach number, wall temperatures, and vehicle length. The large differences in

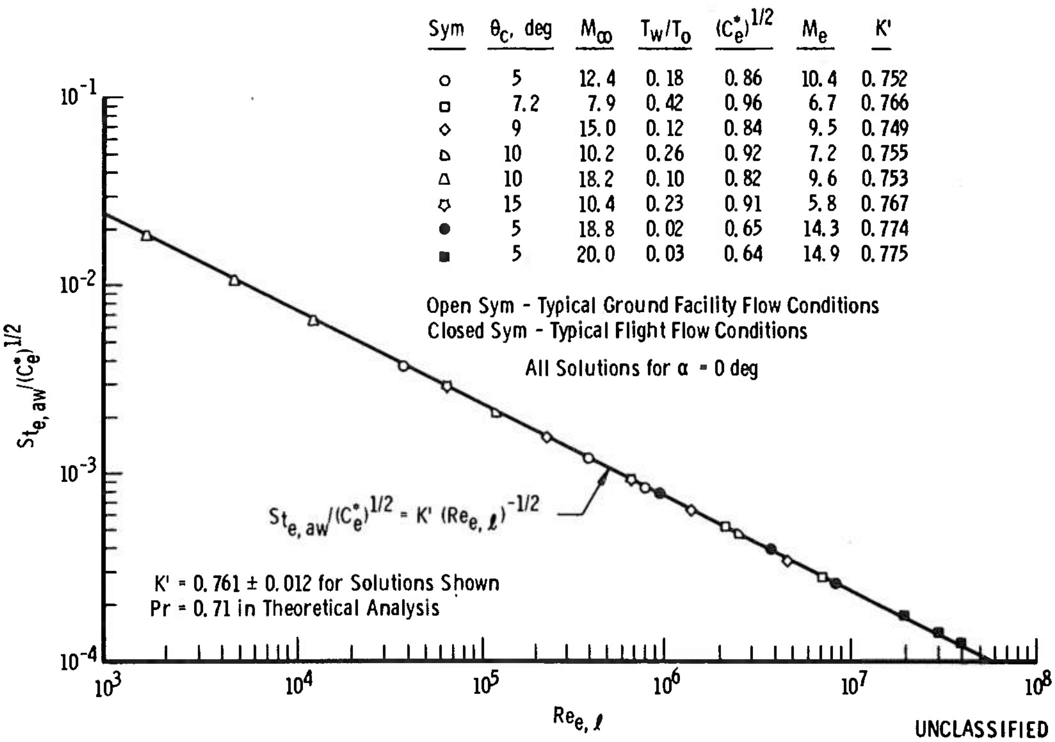


Figure 7. Correlation of VKF boundary-layer solutions with laminar flow.

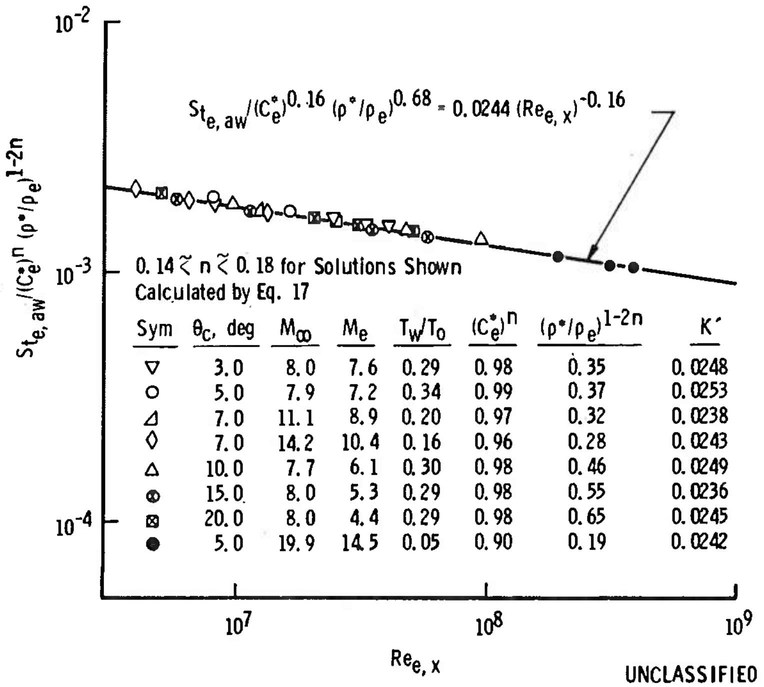


Figure 8. Correlation of VKF boundary-layer solutions with turbulent flow.

the parameters, T_w/T_o, $(C_e^*)^{1/2}$, and M_e should be noted. Using a slope of 1/2, the solutions shown in Fig. 7 yield a value of the constant

$$K' = \sqrt{3}\, K_1/2Pr^{2/3} \tag{24}$$

$$= 0.761 \pm 0.012 \ (\pm 1.6 \text{ percent}).$$

(U) The small variations in the constant K′ are due, at least in part, to small errors in the empirical conical edge relationships utilized (Appendix A). For the range of variables indicated in Fig. 7, the analytic results for laminar flow can be closely expressed as

$$St_{e,aw}/(C_e^*)^{1/2} = 0.761 \ (Re_{e,x})^{-1/2} \tag{25}$$

(U) Because of the variation of n with local incompressible edge Reynolds number, the correlation of the turbulent analytic solutions is not as straightforward. Incompressible and compressible Reynolds number are related by Eq. (15). Figure 8 indicates the result of using a similar series of input conditions in the analytic computer code with an assumed fully turbulent boundary layer. As might be inferred from Fig. 6, the slope of the correlation is dependent on local values of Reynolds number. However, in the range $5 \cdot 10^6 \lesssim Re_{e,x} \lesssim 5 \cdot 10^8$, the correlated analytic values are close to a line described by

$$St_{e,aw}/(C_e^*)^{0.16} \ (\rho^*/\rho_e)^{0.68} = 0.0244 \ (Re_{e,x})^{-0.16} \tag{26}$$

where, if it is assumed that the slope -0.16 is adequate, the constant 0.0244 is accurate to ±4.5 percent (as determined from the analytic solutions). As was the case with laminar flow, the symbols shown in Fig. 8 represent both ground facility and full-scale flight vehicle conditions. Also, the variation of the parameter K′ is due, in part, to small errors in the empirical inviscid edge conditions utilized. The importance of the parameters $(C_e^*)^{1/2}$ and $(C_e^*)^n \ (\rho^*/\rho_e)^{1-2n}$ is discussed in Section 4.5.

4.4 COMPARISON TO OTHER ANALYTIC METHODS

(U) The use of the analytic solution of Adams (Refs. 8 and 9) to justify the present correlation parameters as shown in Figs. 7 and 8 was dictated by convenience. No claim is made herein as to this method's overall superiority to other published theories. The correlated analytic results expressed by Eq. (25) for laminar flow and Eq. (26) for turbulent boundary layers are used as a "baseline" to measure the deviations of the correlated ground facility and flight data. Obviously, if other analytic solutions were employed, different values of K′ would result and higher order theories which include effects such as wall slip, temperature jump, and transverse curvature in the laminar regime could not be expected to behave as a simple power law of Reynolds number.

(U) There are numerous analytic treatments of laminar heat transfer to sharp cones in the literature and no attempt to make a comprehensive review is included herein. The classical Blausius-Mangler boundary-layer solution as discussed by Berry, et al. (Ref. 16) is expressed as

$$\frac{St_{e,aw}}{\sqrt{C_e^*}} = \frac{\sqrt{3}\,(0.332)}{Pr^{2/3}\sqrt{Re_{e,x}}} \tag{27}$$

which, for a Prandtl number of 0.71, reduces to

$$\frac{St_{e,aw}}{\sqrt{C_e^*}} = \frac{0.723}{\sqrt{Re_{e,x}}} \tag{28}$$

(U) Equation (28) predicts local heating rates about 5 percent lower than the value from Eq. (25) (Fig. 9).

(U) The effects of induced pressure coupled with transverse curvature effects were studied by Probstein and Elliot (Ref. 17). The transverse curvature effect is sensitive to the ratio of boundary-layer thickness to body radius and is therefore a function of cone angle at a given test or flight condition. Solutions by this method for 5- and 10-deg cones are shown in Fig. 9. The results indicate that the present correlation should fail at values of $Re_{e,x}$ less than about 10^6. The data of Ref. 16, which were obtained on cones having half-angles from 3 to 30 deg, do not substantiate the large increase in heating rates predicted by Probstein and Elliot. However, as discussed by Boylan (Ref. 18), these data may well have been influenced to some degree by source flow effects peculiar to the type of ground facility used. The important point to be noted in Fig. 9 concerning this analytic method is the decreasing influence of transverse curvature effects with increasing local Reynolds number and increasing cone angle.

(U) The recent analytic results of Rubin, et al. (Ref. 19) and Maus (Ref. 20) which consider leading-edge effects at low density, hypersonic conditions are also shown in correlated form in Fig. 9. These calculations indicate again that if low density effects are of first order, the present method will underpredict the heat-transfer rate at low Reynolds number.

(U) Finally, the laminar thin boundary-layer sharp cone theory of Zoby and the variable entropy theory of Stainback for the Reentry F configuration discussed in Ref. 4 and shown in Fig. 4a is correlated in Fig. 9. As would be expected from Fig. 4, the

results are essentially the same as the method of Adams used herein for the laminar boundary-layer regime.

(U) Turbulent solutions are shown in Fig. 10 compared to the present correlation (Eq. (26)). The comparison between correlation of turbulent boundary-layer analytic methods is not quite as satisfactory as those in the laminar regime. The solutions were chosen at random for sharp, slender cones at zero incidence for wall temperatures in the range $0.03 \lesssim T_w/T_o \lesssim 0.40$ and $8 \lesssim M_\infty \lesssim 20$. The resulting correlated values of local heat-transfer rate fall near (±20 percent) the present correlation curve over the entire Reynolds number range of interest.

(U) The results exhibited in Figs. 7 through 10 demonstrate that the correlation parameters and resulting expressions will serve the purpose of the present study. Since the correlated analytic results did not provide an expression with a high degree of accuracy, there is obviously room for improvement, but the resulting expression exhibits smaller degrees of uncertainty than the available experimental data which will be utilized in the following correlation.

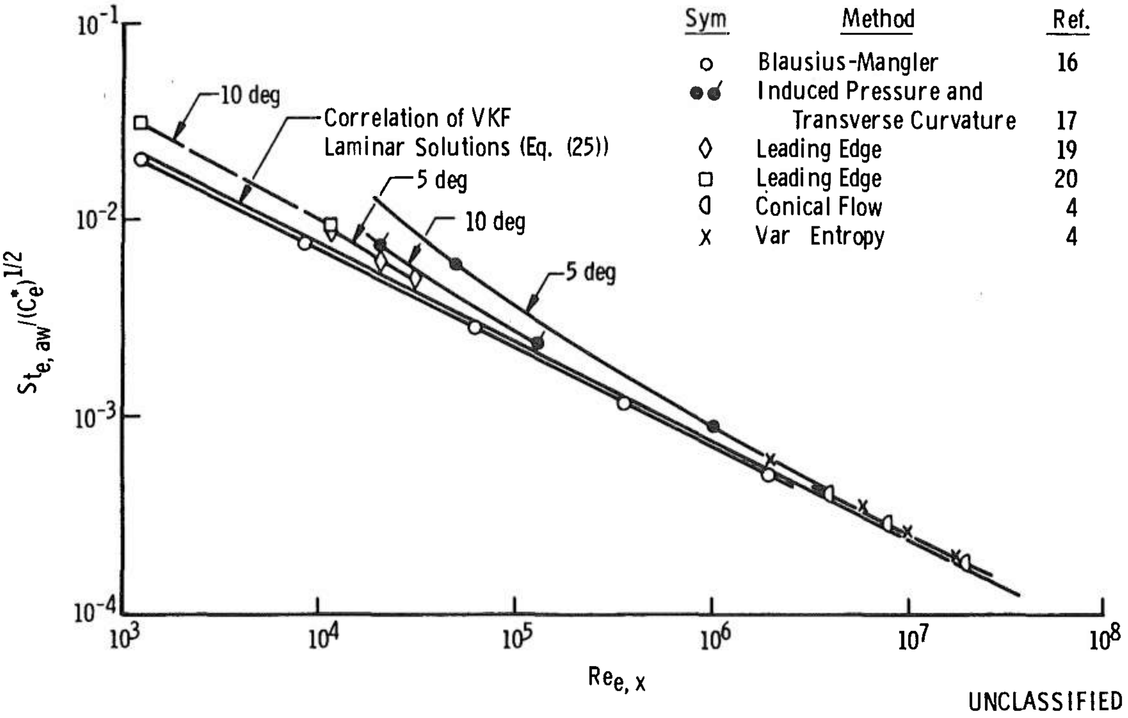


Figure 9. Comparison of correlated VKF laminar solution to other analytic results.

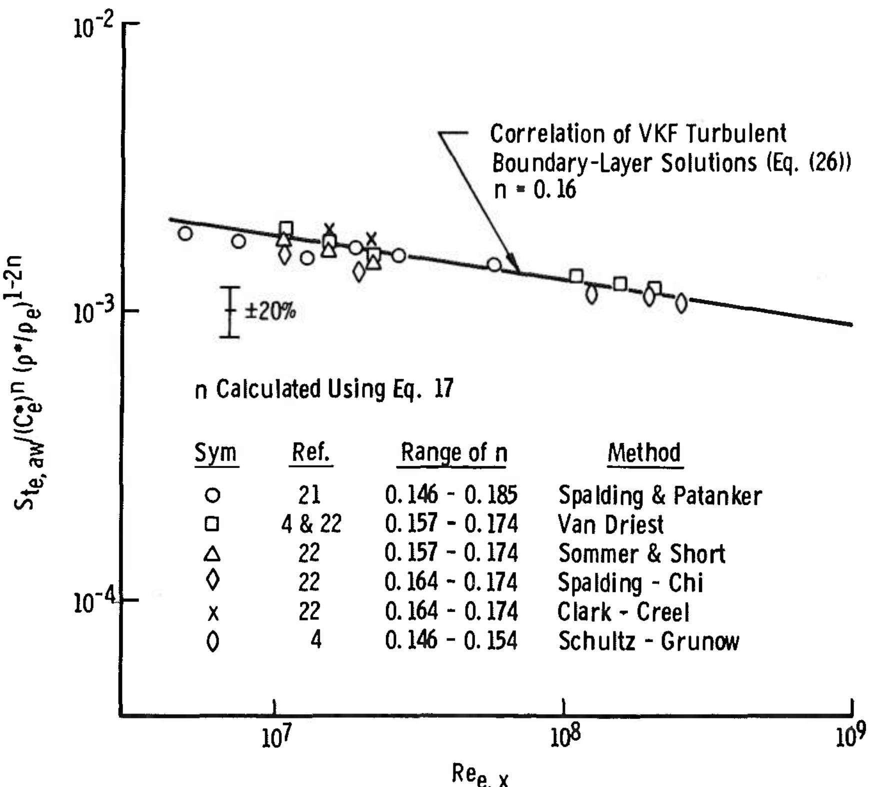


Figure 10. Comparison of correlated VKF turbulent solution to other analytic results.

4.5 THE PARAMETER $(C_e^*)^n$ AND $(C_e^*)^n(\rho^*/\rho_e)^{1-2n}$

(U) The Chapman-Rubesin linear viscosity relationship (C_e^*) appears in numerous analytic methods and correlation equations. It has been shown to be useful in the analysis of test data obtained over a wide range of free-stream flow conditions. For most hypersonic ground facilities, the numerical value of this parameter is close to unity with little variation over the extreme ranges of facility conditions. For this reason, it is sometimes ignored when only ground facility data (from one source) are being studied. An example of the problems introduced by following this technique was documentated by Rehder (Ref. 23) who correlated force measurements on power law bodies much more successfully after inclusion of the viscosity term and Griffith, et al. (Ref. 24) who discuss heat-transfer correlations on delta wings. When comparing ground facility to flight test data, the inclusion of this term is necessary. The large absolute differences in local boundary-layer temperature result in a 30- to 50-percent difference in the value of $(C_e^*)^n$.

(U) Although not a factor in the laminar boundary-layer regime, similar arguments are valid for the parameter $(\rho^*/\rho_e)^{1-2n}$ for turbulent boundary layers. The failure of present

hypersonic ground test facilities to duplicate local boundary-layer conditions must be considered when comparisons are made to flight results.

(U) The variation of the Reentry F Flight values of $(C_e^*)^n$ and $(C_e^*)^n(\rho^*/\rho_e)^{1-2n}$ for both laminar and turbulent boundary-layer-edge conditions compared to the range of these parameters produced in hypersonic ground test facilities is shown below.

Parameter	Present Ground Facility Range	Reentry F Flight Range
$(C_e^*)^{1/2}$	~0.77 - 0.95	~0.68
$(C_e^*)^n(\rho^*/\rho_e)^{1-2n}$	~0.35 - 0.50	~0.23

(U) The slope n for this last parameter is evaluated at the local Reynolds number at the aft end of the flight vehicle or ground facility model and converted to an incompressible form by use of Eq. (17).

(U) The variation of these parameters in the ground facilities and the absolute differences between the facility and flight values indicate that the present correlation method would fail if these terms were set equal to unity.

5.0 CORRELATION OF LAMINAR REENTRY F FLIGHT DATA WITH GROUND FACILITY RESULTS

(~~C~~) As indicated in Fig. 2, more than one-half of the flight data acquisition period provided local heating data under laminar boundary-layer conditions. Also illustrated in Fig. 2 is the fact that nose ablation and trim angle-of-attack values were very small in this portion of the flight trajectory. Typical laminar heating-rate distributions on the flight vehicle are shown in Figs. 4a and 5a.

(U) Laminar flight data in the range 87,000 $\lesssim$ h $\lesssim$ 138,000 feet are shown in correlated form in Fig. 11 and tabulated in Table 1. The correlation parameter, as well as other parameters in Table 1, were calculated by the method of Appendix A from absolute values of heating rate, altitude, velocity, and wall temperature given in Ref. 2. A total of 170 measurements are tabulated in Table 1 with a representative sample being shown in Fig. 11. Viscosity laws utilized for the flight data were Sutherland's relationship in the range 180 $\lesssim$ T $\lesssim$ 2000°R and a linear relationship ($\mu \propto T^{.64}$) for temperatures above 2000°R. These relationships are shown in Fig. 12 compared to some recent air viscosity data (Ref. 31). When computing free-stream and boundary-layer-edge parameters, it is often necessary to employ more than one viscosity law. The lower-temperature-range linear equation was not utilized for the flight data but was for some of the ground facility correlations. The viscosity relationships used herein are summarized as:

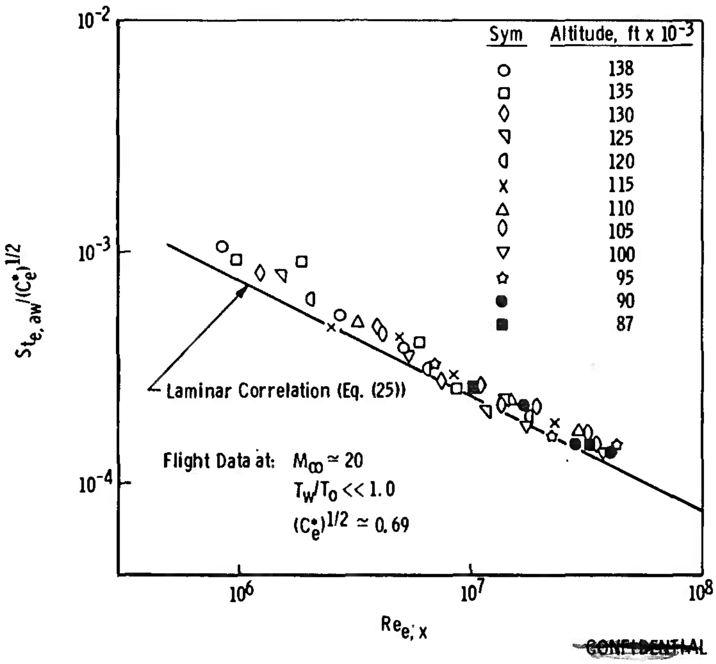


Figure 11. Correlation of laminar Reentry F flight data.

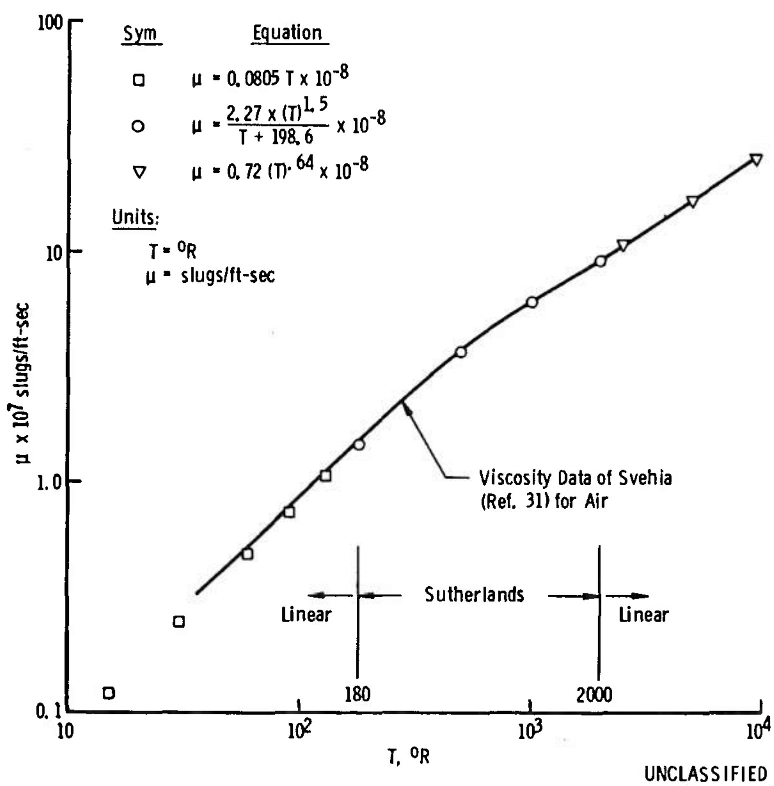


Figure 12. Variation of viscosity with temperature used in present analysis.

$$\left.\begin{array}{ll} 0 \lesssim T < 180 & \mu = 0.0809 \cdot 10^{-8}\ T \\ 180 \lesssim T \lesssim 2000 & \mu = \dfrac{2.27\ (T)^{3/2} \cdot 10^{-8}}{T + 198.6} \\ T > 2000 & \mu = 0.72\ T^{.64} \cdot 10^{-8} \end{array}\right\} \tag{29}$$

where T is in degrees R and μ is in slugs/ft sec.

(U) By defining the difference between a given flight measurement and the correlation of the VKF boundary-layer solution expressed by Eq. (25) as a measure of the "deviation" of the flight data, the correlation method can be evaluated. Defining a parameter L_i as:

$$L_i = 100 \left[\frac{\{St_{e,aw}/(C_e^*)^n\ (\rho^*/\rho_e)^{1-2n}\}_m - \{St_{e,aw}/(C_e^*)^n\ (\rho^*/\rho_e)^{1-2n}\}_c}{\{St_{e,aw}/(C_e^*)^n\ (\rho^*/\rho_e)^{1-2n}\}_c} \right] \tag{30}$$

The mean of this parameter ($\bar{L}$) is then related to the standard deviation σ and the most probable "error" E of the mean by:

$$\bar{L} = \sum_{i=1}^{n} L_i/n \tag{31}$$

$$\sigma = \sqrt{\frac{\sum_{i=1}^{n} L_i^2 - n\bar{L}^2}{n}} \tag{32}$$

$$E = \frac{0.6745}{\sqrt{n(n-1)}} \sqrt{\sum_{i=1}^{n} (\bar{L} - L_i)^2} \tag{33}$$

where n is the data sample size in Eqs. (31), (32), and (33).

(U) Numerical values of these parameters for the flight data are tabulated in Table 4. It should be noted that the parameter E is an absolute value of the probable error of the parameter $\bar{L}$. It can be interpreted as representing one-half the area of a normal distribution curve where the 2σ limits would represent about 95 percent of the area. Values of E and σ tabulated in Table 4 are sensitive to the sample size selected and do not represent a measure of the accuracy of the flight or ground facility measurements.

(~~C~~) The mean of the difference between the flight data and the present correlation (Eq. (25)) is about 16 percent. Zoby and Rumsey (Ref. 4) quoted a value of 20 percent for the flat-plate laminar method and 10 to 15 percent for laminar solutions utilizing

variable entropy edge conditions. As mentioned earlier, all parameters illustrated in Fig. 11 were calculated with perfect-gas relationships. It can therefore be argued that the difference between the correlation curve (Eq. (25)) and the flight data is due to real-gas effects. However, a hand calculation using real-gas thermodynamic properties indicated that the flight data would shift by no more than 6 percent in comparison to the correlation curve at the higher altitudes and 4 percent at the lower altitudes. Since the flight was specifically designed to avoid real-gas effects, this is hardly surprising. It is highly likely that induced pressure and/or variable entropy edge conditions should be considered in this flight regime if highly accurate analytic predictions are required.

(U) The open literature abounds with surface heat-transfer-rate measurements on sharp slender cones at zero incidence with laminar boundary layers. One of the basic requirements of the present study was that both the flight data and ground facility data be examined in a consistent manner using the relationships derived in Section 3.0 and the perfect-gas and empirical edge conditions discussed in Appendix A. The use of published laminar data was therefore limited to reports which obeyed the following restrictions:

1. Preferably, available data be given in tabular form with heat-transfer rate $\dot{q}$ rather than Stanton number being used if possible.

2. If Stanton number or heat-transfer coefficients are given rather than $\dot{q}$, enough information must be provided to work back to a measured heat-transfer rate.

3. For a given data point, enough information must be provided to calculate the instrumentation location in terms of cone slant length.

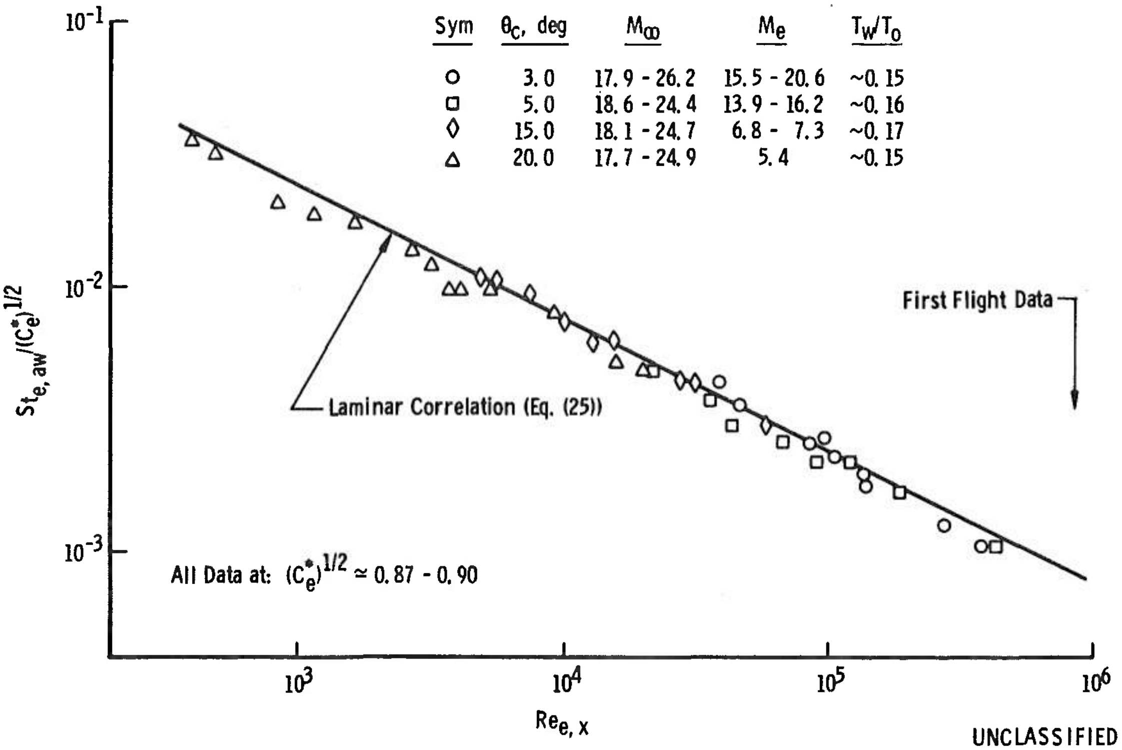
4. Plotted data could be used only if the scale could be read to sufficient accuracy.

(U) These requirements severely restricted the volume of available hypersonic data which were studied. The resulting data represented test conditions in two hypersonic tunnels at Princeton (Tunnel N-3 and N-5), one at NOL (NOL Hypersonic Tunnel), one at NASA-Langley (11-in. Hypersonic), and four hypersonic tunnels at the AEDC (VKF - B, C, F, and M).

(U) Laminar boundary-layer heat-transfer-rate data were extracted from Refs. 16, 18, 22, and 25 through 30 for the present correlation. Table 2 tabulates facility flow conditions and test model information for each of these experimental studies. For the AEDC VKF studies, tabulated data and test details were available to the author when insufficient information was contained in the referenced reports. Table 3 tabulates all

laminar boundary-layer heat-transfer-rate distributions with the corresponding correlation parameter and other pertinent information. A representative sample of each data source is shown in Fig. 13. Numerical values of the parameters defined by Eqs. (30) through (33) are tabulated in Table 4.

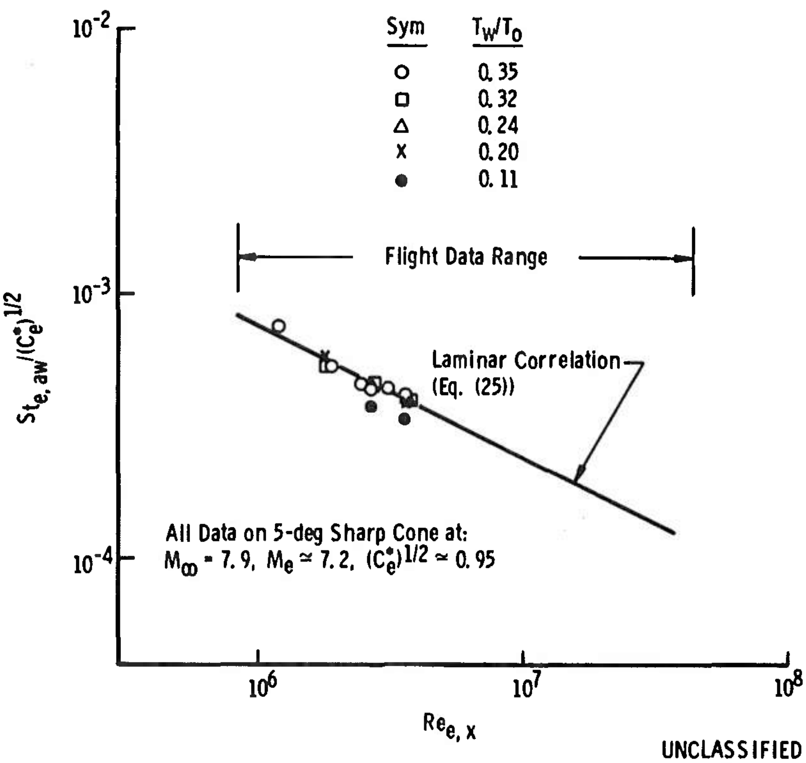
(U) The Princeton low density data (Ref. 16) are slightly below the correlation results expressed by Eq. (25). Also, the 3-deg cone data do not exhibit any transverse curvature effects. This facility utilizes conical nozzles which may result in significant errors of 15 to 30 percent due to source flow. This problem is discussed in Ref. 18. The data represent altitudes greater than those of interest here. The initial local edge Reynolds number for the Reentry F data acquisition period is indicated in Fig. 13a.



a. Princeton Hypersonic Tunnels N-3 and N-5 (Ref. 16)
Figure 13. Correlation of laminar ground facility data.

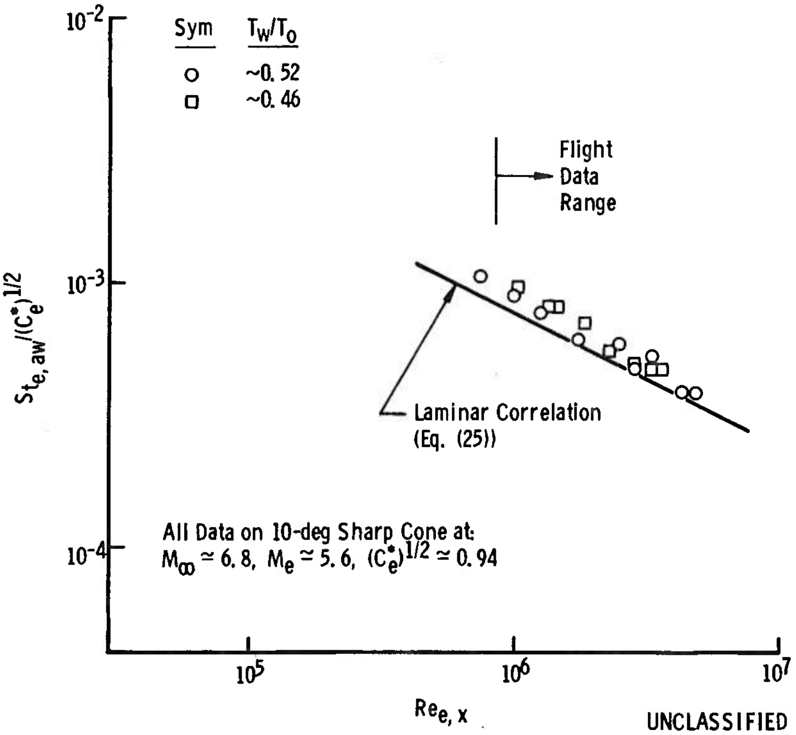
(U) A small amount of laminar boundary-layer heating distribution data on a 5-deg sharp cone obtained in the NOL hypersonic tunnel is presented in Ref. 22. The data were all obtained at Mach 7.9 and wall temperature was varied by a model precooling technique resulting in data in the range $0.11 \lesssim T_w/T_o \lesssim 0.35$. Except for the lowest wall temperature results, the NOL data are slightly below the present correlation relationship (Fig. 13b). The parameters tabulated in Table 4 were calculated without

including these particular data. It was suggested in Ref. 22 that because of the rapid change in the specific heat of the model material at very low temperatures, the results at $T_w/T_o = 0.11$ should be regarded as tentative.



b. NOL Hypersonic Tunnel (Ref. 22)
Figure 13. Continued.

(U) The boundary-layer transition study of Ref. 25 conducted in the NASA-Langley 11-inch hypersonic tunnel included laminar boundary-layer heating distribution under moderately hot wall ($T_w/T_o \approx 0.47$ and 0.52) conditions on a 10-deg sharp cone at Mach 6.8. Figure 13c indicates that these data are slightly above the present correlation curve and agree quite well with the Reentry F results (Fig. 11). Information contained in Ref. 25 allows a partial cross-check of the calculation procedures used in the present analysis (Appendix A). As stated earlier, empirical relationships were derived to approximate the required inviscid edge parameters. This can lead to small differences in various parameters when comparisons are made to published results which use other methods at arriving at the boundary-layer-edge conditions. There are other sources of error which should be considered. For example, the present method uses a value for the gas constant of air as 1717.60 ft^2/sec^2 °R. For data from sources utilizing other values (such as 1775.9 ft^2/sec^2 °R for nitrogen) slight inconsistencies develop.

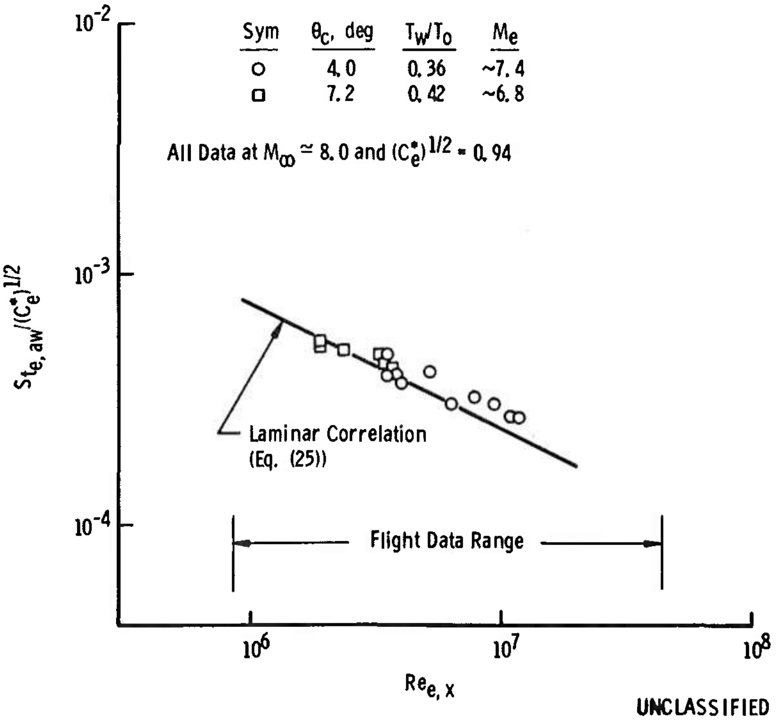


c. Langley 11-inch Hypersonic Tunnel (Ref. 25)
Figure 13. Continued.

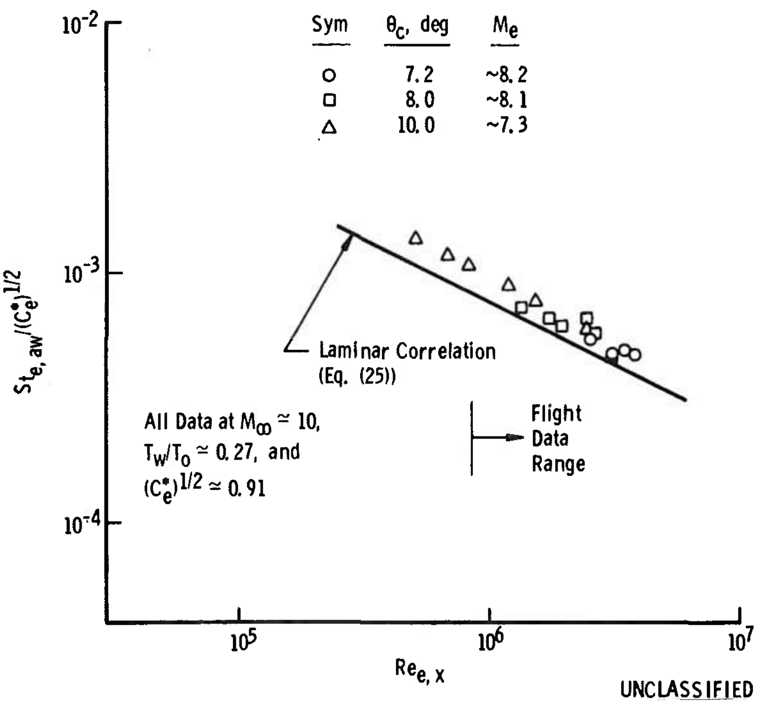
(U) Values tabulated in Ref. 25 indicated local Mach numbers about 6 percent lower than values calculated by the present method and values of Re_e/Re_∞ about 4 percent lower. These differences would not materially change the correlation shown in Fig. 13c. A more detailed discussion of the limitations and accuracy of the present method is given in Appendix A.

(U) Some typical hypersonic Mach 8 data from the VKF 50-in. Tunnel B are shown in Fig. 13d (Refs. 26 and 27). The data fall near to or slightly above the correlation curve represented by Eq. (25). The data represent warm wall measurements on 4.0- and 7.2-deg sharp cones.

(U) Laminar Mach 10 data from the VKF Hypersonic Tunnel C (Refs. 27 through 29) on 7.2-, 8.0-, and 10.0-deg sharp cones are shown in Fig. 13e. A level slightly above those from the Mach 8 Hypersonic Tunnel B (Fig. 13d) is indicated. The wall-to-total-temperature ratio was about 0.27 for these data since higher stagnation temperatures are required to prevent condensation effects.



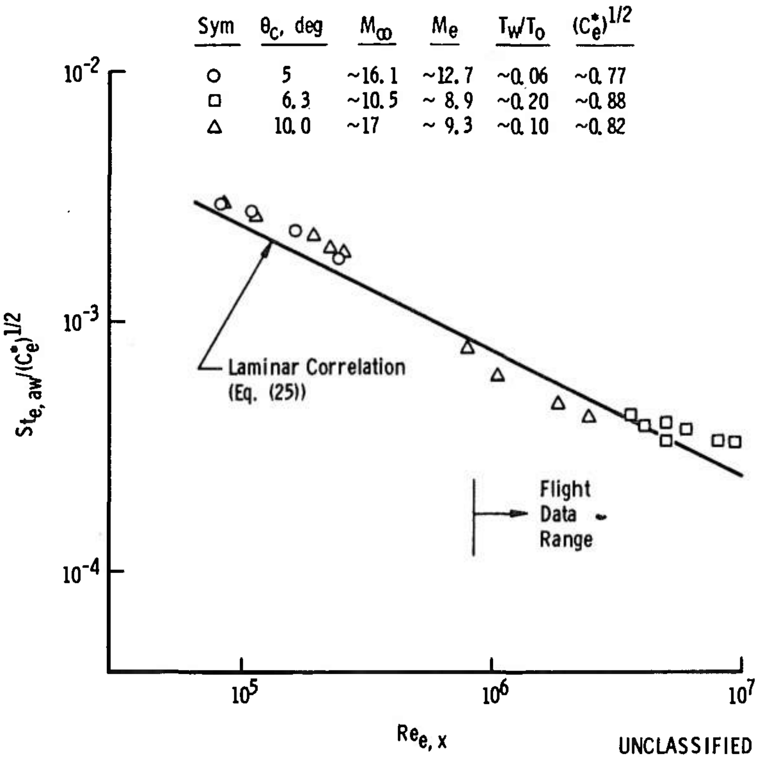
d. VKF Hypersonic Tunnel B (Refs. 26 and 27)



e. VKF Hypersonic Tunnel C (Refs. 27, 28, and 29)

Figure 13. Continued.

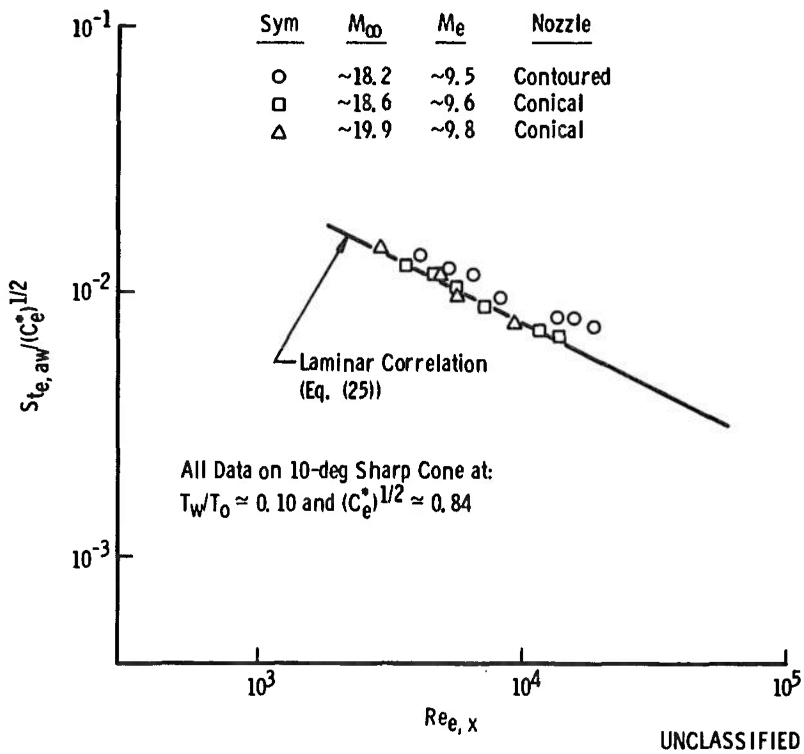
(U) Hypersonic data from the VKF 108-in. arc-driven hypervelocity Tunnel F are shown in Fig. 13f. The data represent typical heat-transfer measurements on sharp slender cones obtained in the 54-in. test section (conical nozzle) at Mach numbers near 10 and at the 108-in. test section at Mach numbers near 17 (Refs. 29 and 30). In general, the data fall slightly above the present correlation relationship. This facility differs from the others represented in Fig. 13 in length of flow duration and instrumentation techniques used.



f. VKF 108-inch Hypervelocity Tunnel F (Refs. 29 and 30)
Figure 13. Continued.

(U) Figure 13 concludes with some typical low density hypersonic data (Ref. 18). These data can be compared directly to those shown in Fig. 13a. The tests reported in Ref. 18 were conducted in both contoured and conical nozzles to study the influence of source-like flow on heat-transfer measurements. The data are identified as to nozzle type with the contoured nozzle results seen to be from 5 to 10 percent higher than the conical nozzle results. These latter measurements are in fair agreement with the Princeton N-3 and N-5 tunnel data shown in Fig. 13a which were also obtained in source-like flows. As was the case of the earlier Princeton low density data, the tunnel data are of only academic interest since altitudes greater than the present flight measurements were

simulated. The parameters tabulated in Table 4 were computed individually for the contoured and conical nozzle results.



g. VKF Low Density, Hypersonic Tunnel M (Ref. 18)
Figure 13. Concluded.

(~~C~~) Information tabulated in Table 4 was used to prepare Fig. 14. The data sample size for each hypersonic facility is inadequate to allow any critical judgement of a particular facility, and it was not the purpose of the present analysis to perform any such judgements. However, it was desired to determine if (sometimes hot wall) ground facility data obtained at local values of edge Mach and Reynolds numbers and local boundary-layer temperatures significantly smaller than full-scale flight values could be directly compared to such flight results. The summary correlation represented in Fig. 14 suggests that, at least in the laminar boundary-layer regime, hypersonic ground test facilities are quite adequate in providing design test information on local heating rate. The problem studied herein is admittedly much easier than can be expected on more advanced reentry vehicles with complex control surfaces and lifting flight. The problem of accurately determining the proper inviscid edge conditions is a formidable analytic and experimental problem on such configurations. Ground test programs should stress boundary-layer surveys with conventional techniques and development of advanced boundary- and shock-layer measurement systems should be continued.

Sym	Source	Ref.	θ_c, deg	M_∞	M_e	T_w/T_o	$(C_e^*)^{1/2}$
○	Princeton	16	3 - 20	~18 - 26	~5 - 21	~0.16	~0.87 - 0.90
□	NOL	22	5	~7.9	~7.2	~0.11 - 0.35	~0.95
△	Langley	25	10	~6.8	~5.6	~0.46 - 0.52	~0.94
◇	VKF-B	26, 27	4 - 7.2	~8.0	~6.8 - 7.4	~0.36 - 0.42	~0.94
○	VKF-C	27 - 29	7.2 - 10	~10	~7.3 - 8.2	~0.27	~0.91
△	VKF-F	28, 30	5 - 10	~10 - 17	~8.8 - 12.7	~0.06 - 0.20	~0.77 - 0.82
□	VKF-M	18	10	~18 - 20	~9.6	~0.10	~0.84
●	Flight	2	5	~18.7 - 20	~14 - 14.6	<< 1.0	~0.69

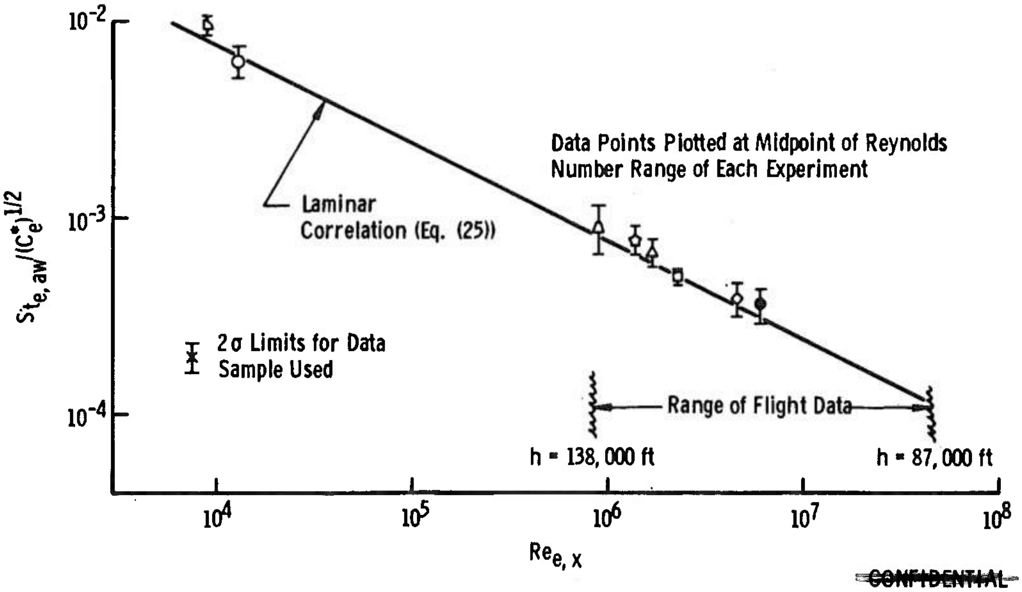


Figure 14. Summary comparison of hypersonic ground facility results with Reentry F flight data with laminar boundary-layer conditions.

(U) All correlations are subject to reevaluation as more information becomes available. Appendix A contains details of the present method which will allow other sources of data (or analytic methods) to be added.

6.0 CORRELATION OF TURBULENT REENTRY F FLIGHT DATA WITH GROUND FACILITY RESULTS

(C) Turbulent boundary-layer heat-transfer measurements were obtained on the Reentry F vehicle in the range 90,000 $\lesssim$ h $\lesssim$ 45,000 ft. However, analysis of data below 60,000 ft is highly questionable due to thermal distortion, angle of attack, and tip-blunting effects. Considerable differences between the zero- and 180-deg model ray (for angle of attack less than 1 deg) were observed. As can be seen in Fig. 2, the turbulent regime was influenced by nose bluntness and vehicle incidence much more than the laminar regime. Although empirical equations are presented in Ref. 4 to account for angle-of-attack effects,

the flight data presented in this section have not been adjusted by these relationships. They are, instead, identified as windward or leeward data with the corresponding local angle of attack.

(C) Turbulent flight data in the range 60,000 $\lesssim$ h $\lesssim$ 90,000 ft are shown in correlated form in Fig. 15 and tabulated in Table 5. The correlation parameter, as well as other parameters in Table 5, were calculated by the method of Appendix A from absolute heating-rate values, altitude, velocity, and wall temperatures given in Ref. 2. Viscosity laws utilized are given by Eq. (29).

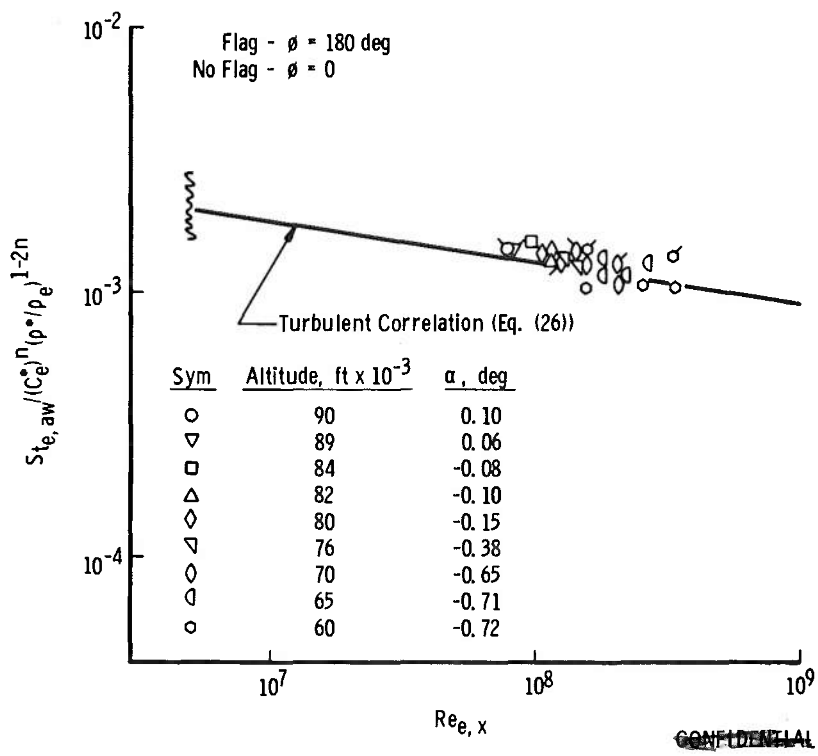


Figure 15. Correlation of turbulent Reentry F flight data.

(C) As might be expected, flight data scatter more in the turbulent boundary-layer regime than in the laminar (Fig. 11). This is partly due to the sensitivity of heating rates to local flow variations as described above. Again, using Eqs. (30) through (33) as a means of evaluating the "accuracy" of the correlation, the numerical value of $\overline{L}$ indicates an average flight value about 8.5 percent (Table 5) above the present correlation (Eq. (26)). The 2σ limits are relatively large, as was the case for the laminar data; but the probable error of the mean is only about 0.6 percent. A similar analysis presented by Zoby and Graves (Ref. 5) quoted a best fit for flight data to an analytical solution using a similar

transformation method with the Schultz-Grunow incompressible relation and the Colburn Reynolds analogy†. A value of $\bar{L}$ of 2.407 was given with the root-mean-square error,

$$\epsilon_{RMS} = \sqrt{\frac{\sum_{n=1}^{n} L_i^2}{n}} \tag{34}$$

of 11.55. The data tabulated in Table 5 yield a value of 12.6 using the present correlation technique. The difference between the present 8.5-percent deviation between analytic and flight results and the 2.4 percent quoted in Ref. 5 is due largely to small inaccuracies in the present empirical edge condition relationships. The present method of using the distance from the virtual origin‡ as the reference length rather than the distance from peak heating or to onset of transition is also a factor. Depending on the analytic method selected, Zoby and Graves quoted values of $\bar{L}$ from 1.4 to 15.7 percent. They also noted that ground test and flight data did not give consistent values of $\bar{L}$ and ϵ_{RMS} when using the same analytic method. The present state-of-the-art of turbulent boundary-layer heating analyses does not allow any one method or approach to be recommended as the one proper technique.

(~~C~~) The general rules for selection of ground facility data for the present correlation in the turbulent regime were the same as in the laminar cases discussed in Section 5.0. In addition, there is some concern that the use of boundary-layer trips in some cases distorts the inviscid flow field, so it was decided to utilize only ground facility data which represented natural transition. The term "natural" is meant that tubulent flow was not deliberately induced by surface roughness. This severely restricts the availability of turbulent data since ground facilities which produce the required unit Reynolds number, and can test large models, are not very common in the hypersonic flow regime. The recent addition of a high unit Reynolds number ($Re_\infty/ft \approx 70 \times 10^6$) Mach 8 contoured nozzle in the VKF Hypersonic Tunnel F has allowed additional smooth body turbulent boundary-layer studies to be made. This nozzle and other recent advances in test techniques are described by Pate and Eaves (Ref. 32).

(U) Turbulent boundary-layer heat-transfer-rate data were extracted from Refs. 22, 25, 27, 29, 30, and 32 for the present correlation. Table 6 tabulates facility flow conditions and test model information for each of these experimental studies. For the AEDC VKF studies, tabulated data and test details were available to the author when insufficient information was contained in the referenced reports. Table 7 tabulates all turbulent

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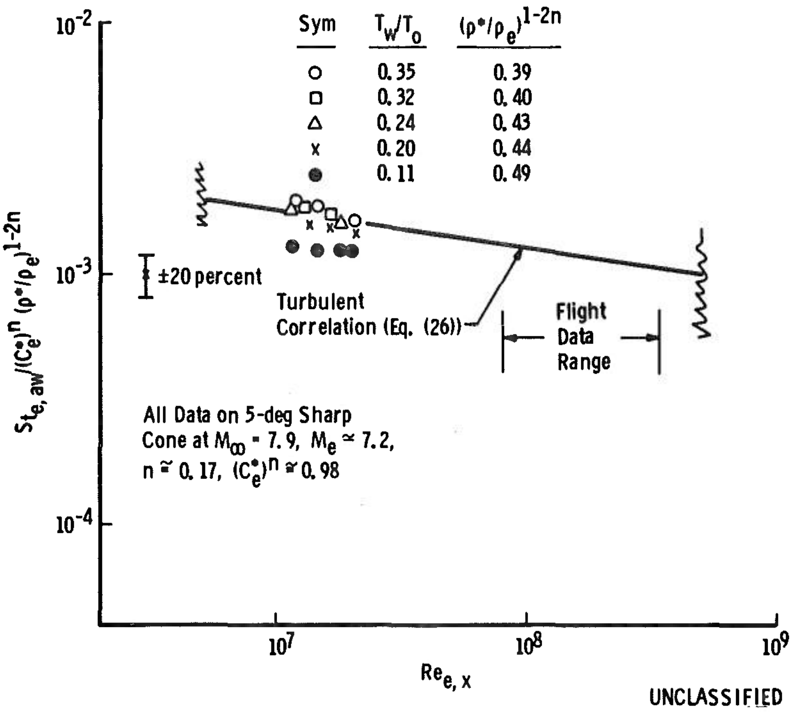
†Reference length measured from transition

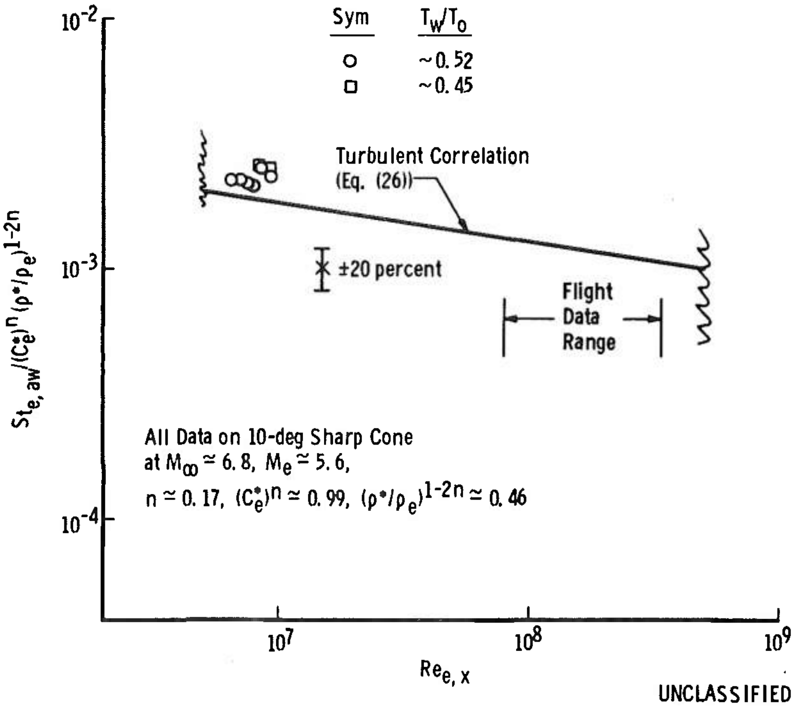
‡Utilized so that the results will be useful from a design or test planning viewpoint

boundary-layer heat-transfer-rate distributions with the corresponding correlation parameter and other pertinent information. A representative sample of each data source is shown in Fig. 16. Numerical values of the parameters defined by Eqs. (30) through (33) are tabulated in Table 8.

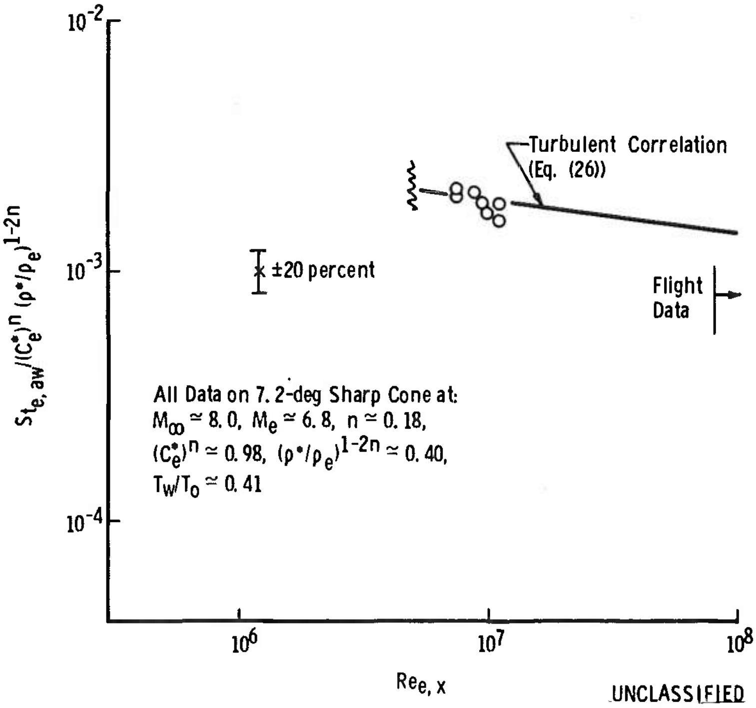


a. NOL Hypersonic Tunnel (Ref. 22)
Figure 16. Correlation of turbulent Reentry F ground facility data.

(U) The 10-deg sharp cone data published in Ref. 22 from the NOL hypersonic tunnel represent largely transitional and turbulent flows. The limited amount of laminar data were presented in Fig. 13. Figure 16a presents typical turbulent values in the present correlated form. Model wall temperature was varied by a model precooling technique which reduced initial model wall temperature to as low as 160°R (-300°F). As was the case for the laminar boundary-layer data, the turbulent data are in good agreement with the present correlation (Eq. (26)) except for the coldest wall temperature case. The parameters tabulated in Table 8 were calculated without consideration of these data. One of the conclusions implicit from the turbulent correlation (Fig. 8) is that the parameter $(C_e^*)^n(\rho^*/\rho_e)^{1-2n}$ should remove wall temperature effects over the range 0.05 $\lessapprox T_w/T_o \lessapprox$ 0.34. The general trend of the NOL data is contradictory to this. That is, a slight decrease in Stanton number was observed in the range 0.20 $\lessapprox T_w/T_o \lessapprox$ 0.34 with a sharp decrease at $T_w/T_o \approx 0.11$. Theoretical solutions indicate a slight increase in Stanton number should have resulted rather than the measured behavior.

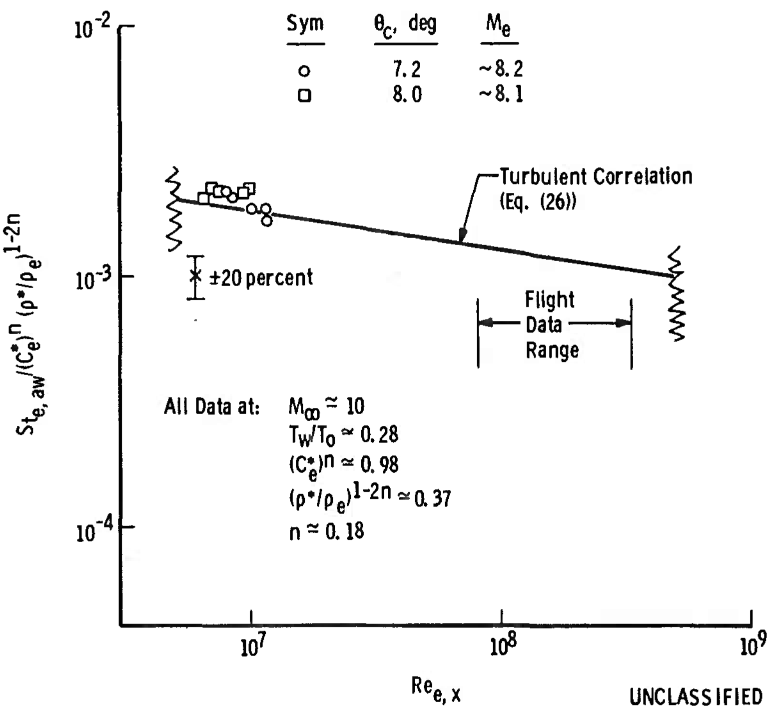


b. Langley 11-inch Hypersonic Tunnel (Ref. 25)



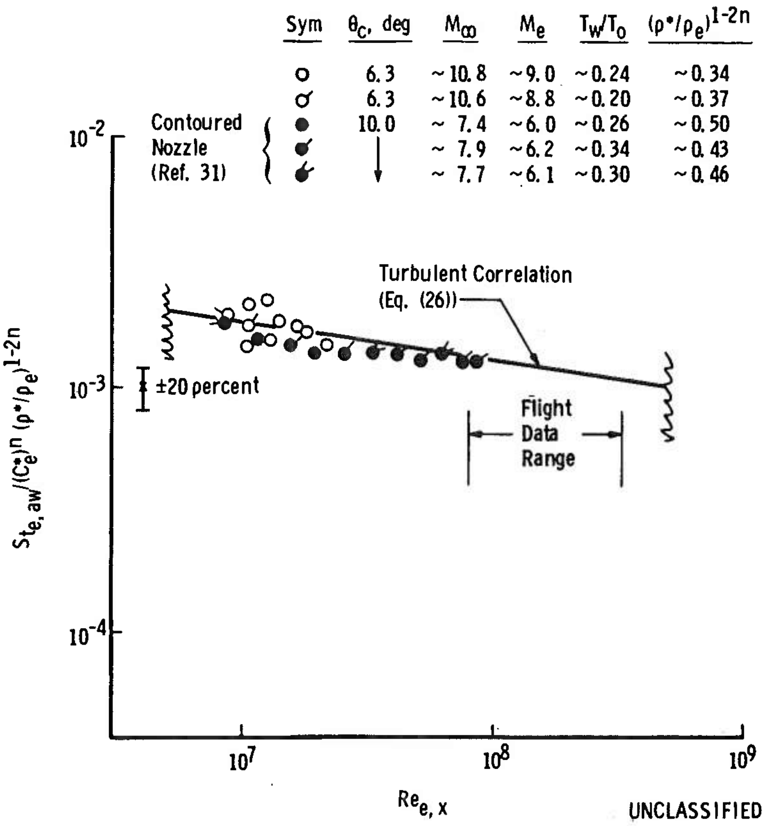
c. VKF 50-inch Hypersonic Tunnel B (Ref. 27)
Figure 16 Continued.

(U) The boundary-layer transition study reported in Ref. 25 contains mostly laminar and transitional data. A few fully turbulent results are presented and are shown in Fig. 16b using the present correlation method. Although the data sample size is very small, the average value ($\bar{L}$) is significantly above the correlation given by Eq. (24). As was the case of the NOL data sample, the range of local edge Reynolds numbers covered by the selected data sample is small.



d. VKF 50-inch Hypersonic Tunnel C (Refs. 27 and 29)
Figure 16. Continued.

(U) Turbulent boundary-layer hypersonic data from the VKF facilities are shown in Figs. 16c, 16d, and 16e. In all three sets, the data are in fair agreement with the present correlation equation. The results from the high unit Reynolds number Mach 8 nozzle in the Hypervelocity Wind Tunnel (F) exhibit a data level slightly below the correlation curve. It should also be noted that data obtained in this new nozzle (on cones) are the only set found by the writer which effectively match the values of local edge Reynolds numbers experienced in flight.



e. VKF 108-inch Hypervelocity Tunnel F (Refs. 30 and 32)
Figure 16. Concluded.

(U) Data tabulated in Table 8 were used to prepare the turbulent summary shown in Fig. 17. As was the case of the laminar summary (Fig. 14), the data from both the hypersonic ground test facilities and full-scale flight results fall just above the present correlation curve expressed by Eq. (26). The relatively small sample size used from each facility resulted in large 2σ limits. Although the variation of wall temperatures between flight and ground test sources was quite large, it appears that the present correlation effectively removes this parameter. In both the laminar and turbulent regimes, the NOL results (which used the model precooling technique) suggest a slightly lower heating rate than would be indicated from the other results studied. Figure 17 also reveals the need for hypersonic turbulent boundary-layer data at higher local edge Reynolds numbers to duplicate typical flight values.

Sym	Source	Ref.	θ_c, deg	M_∞	M_e	T_w/T_o	n	$(C_e^*)^n$	$(\rho^*/\rho_e)^{1-2n}$
□	NOL	22	5.0	~ 7.9	~ 7.2	0.11 - 0.35	~0.17	~0.99	~0.40 - 0.49
△	Langley	25	10.0	~ 6.9	~ 5.6	0.45 - 0.52	~0.17	~0.99	~0.46
◇	VKF-B	27	7.2	~ 8.0	~ 6.8	~0.41	~0.18	~0.98	~0.39
✿	VKF-C	27, 29	7.2, 8.0	~10.0	~8.0, 8.2	~0.28	~0.18	~0.98	~0.36
△	VKF-F	30, 32	63, 10.0	~7.5 - 10.0	~6.0, 9.0	~0.20 - 0.35	~0.14 - 0.18	~0.98	~0.34 - 0.50
●	Flight	2	5.0	~20.0	~14.6	<<1.0	~0.14 - 0.16	~0.91	~0.22

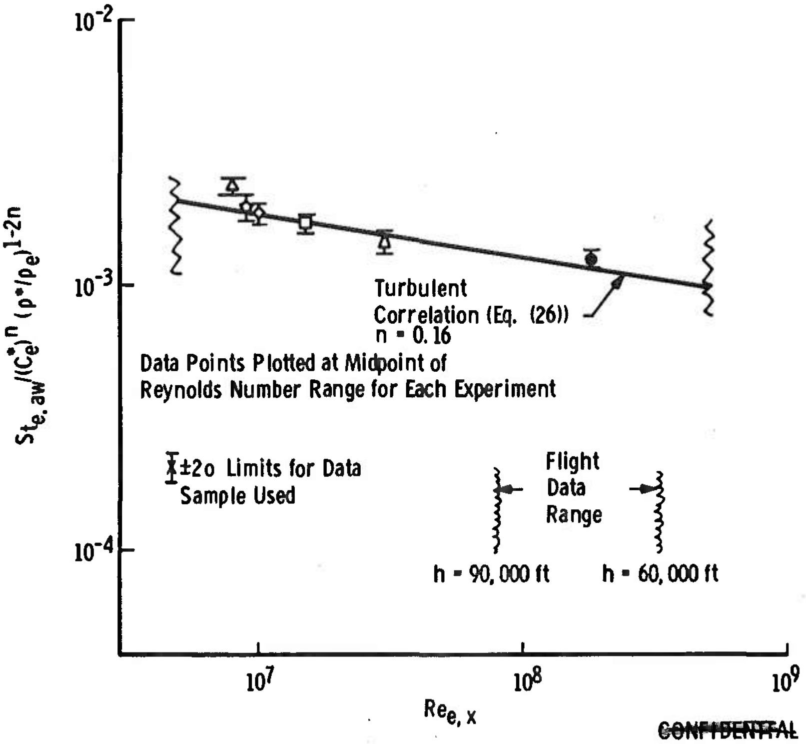


Figure 17. Summary comparison of hypersonic ground facility results with Reentry F flight data with turbulent boundary-layer conditions.

7.0 CONCLUDING COMMENTS

(~~C~~) The results of the present analysis are shown in a simplified graphic form in Fig. 18. The results indicate that full-scale flight surface heating rate data can be directly compared to perfect gas, relatively hot wall, ground facility measurements. The present problem is an admittedly easy one since the required local boundary-layer-edge conditions were easily calculated and the quality of the flight data was far superior to that normally available. Similar techniques should be attempted on more complex flight configurations to ascertain if similar results can be obtained.

(U) The present method employs a straightforward engineering approach to develop the necessary correlation parameters and avoids the use of a characteristic length which is not known apriori. The required constants of proportionality were determined from an analytical boundary-layer method in both the laminar and fully turbulent boundary-layer regimes. The resulting expressions slightly underpredict the bulk of the ground facility and flight data, but the results illustrate good correlation between the two sources of data.

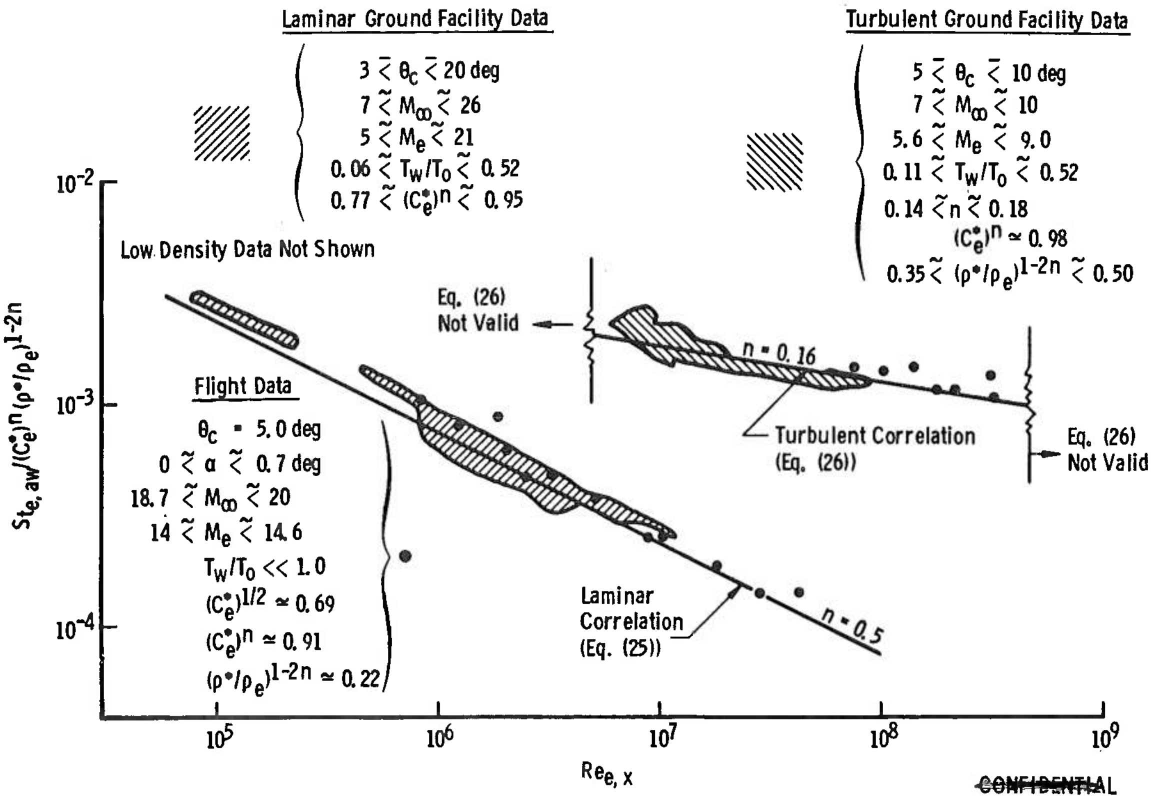


Figure 18. Local heating rate comparison between ground test facility and full-scale flight for laminar and fully turbulent boundary-layer conditions.

(~~C~~) Rather than using analytical boundary-layer solutions to arrive at the constants of proportionality, the experimental data could also have been used. Using a least-squares curve fit of the form $y = AX^B$ and all of the tabulated data in Tables 1, 3, 5, and 7 except the low-density data from the Princeton hypersonic tunnels and the VKF Tunnel M, and the coldest wall data from NOL (Figs. 13b and 16a), equations for the laminar and turbulent flow regimes were developed as follows:

$$St_{e,aw}/(C_e^*)^{0.507} = 0.951 \ (Re_{e,x})^{-0.507} \tag{35}$$

and

$$St_{e,aw}/(C_e^*)^{0.15} \ (\rho^*/\rho_e)^{0.70} = 0.0199 \ (Re_{e,x})^{-0.15} \tag{36}$$

Equations (35) and (36) represent an engineering curve fit of experimental data while Eqs. (25) and (26) utilize an analytic technique. If plotted on Fig. 18, Eq. (35) would be slightly above the result of Eq. (25), and Eq. (36) would be very close to Eq. (26) up to a value of $Re_{e,x}$ of about 3 x 10^7 and be slightly above at greater Reynolds numbers. Different data samples would yield different constants in these latter equations as would the use of an analytic approach other than the one used herein in Eqs. (25) and (26).

(U) Values tabulated in Fig. 18 indicate the wide variation between ground test and flight values of the local and free-stream Mach numbers, wall temperatures, reference viscosity term $(C_e^*)^n$, and reference boundary layer to edge density ratios $(\rho^*/\rho_e)^{1-2n}$.

(U) The present technique involves the use of several empirical relationships which introduce the possibility of large errors if they are used beyond the range for which they are derived. A discussion of this potential problem area is included in Appendix A. The reader and user of this correlation method should adopt the attitude of systematic questioning (Ref. 1). It is hoped that sufficient information is included herein to make the current analysis of interest to a larger group than is normally the case. Additional experimental results not available to the author would be most useful in evaluating the present correlation technique.

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Table 1. Laminar Flight Data

REENTRY F LAM. DATA. ALT EQUAL 138000 FT. ZERO DEG. RAY. ALPHA EQUAL .1 DEG.

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1874E 02	0.4638E 03	0.6430E 03	0.1947E-01	0.4318E 07	0.5000E 01	0.1305E 02	0.1400E 02	0.1380E 06	0.1979E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.4559E 01	0.5170E 01	0.1766E 01	0.9930E 00	0.2907E 01	0.8218E 07

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.103	0.50	50.0000	0.0017647	0.0007228	0.4448E 06	0.8465E 06	0.6883	0.1000E 01	0.105005E-02	0.827147E-03	0.269486E 02
0.199	0.50	35.0000	0.0012353	0.0005059	0.8593E 06	0.1635E 07	0.6883	0.1000E 01	0.735036E-03	0.595080E-03	0.235190E 02
0.257	0.50	30.0000	0.0010588	0.0004337	0.1110E 07	0.2112E 07	0.6883	0.1000E 01	0.630031E-03	0.523643E-03	0.203170E 02
0.334	0.50	30.0000	0.0010588	0.0004337	0.1442E 07	0.2745E 07	0.6883	0.1000E 01	0.630031E-03	0.459333E-03	0.371620E 02
0.380	0.50	27.0000	0.0009529	0.0003903	0.1641E 07	0.3123E 07	0.6883	0.1000E 01	0.567028E-03	0.430636E-03	0.316723E 02
0.468	0.50	22.0000	0.0007765	0.0003180	0.2021E 07	0.3846E 07	0.6883	0.1000E 01	0.462023E-03	0.388042E-03	0.190651E 02
0.545	0.50	22.0000	0.0007765	0.0003180	0.2353E 07	0.4479E 07	0.6883	0.1000E 01	0.462023E-03	0.359586E-03	0.284872E 02
0.635	0.50	21.0000	0.0007412	0.0003036	0.2742E 07	0.5218E 07	0.6883	0.1000E 01	0.441022E-03	0.333131E-03	0.323869E 02
0.699	0.50	20.0000	0.0007059	0.0002891	0.3018E 07	0.5744E 07	0.6883	0.1000E 01	0.420020E-03	0.317514E-03	0.322842E 02
0.776	0.50	20.0000	0.0007059	0.0002891	0.3351E 07	0.6377E 07	0.6883	0.1000E 01	0.420020E-03	0.301350E-03	0.393797E 02
0.853	0.50	19.0000	0.0006706	0.0002746	0.3683E 07	0.7010E 07	0.6883	0.1000E 01	0.399019E-03	0.287426E-03	0.388249E 02
0.924	0.50	20.0000	0.0007059	0.0002891	0.3990E 07	0.7593E 07	0.6883	0.1000E 01	0.420020E-03	0.276163E-03	0.520915E 02

NOTE: See Appendix A for Nomenclature for Tables

REENTRY F LAM. DATA. ALT. EQUAL 138000 FT. 180 DEG. RAY. ALPHA EQUAL .1 DEG.

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1874E 02	0.4638E 03	0.6380E 03	0.1932E-01	0.4318E 07	0.5000E 01	0.1305E 02	0.1400E 02	0.1380E 06	0.1979E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.4559E 01	0.5170E 01	0.1766E 01	0.9930E 00	0.2907E 01	0.8218E 07

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.334	0.50	25.0000	0.0008822	0.0003613	0.1442E 07	0.2745E 07	0.6883	0.1000E 01	0.524894E-03	0.459333E-03	0.142731E 02
0.468	0.50	20.0000	0.0007058	0.0002890	0.2021E 07	0.3846E 07	0.6883	0.1000E 01	0.419915E-03	0.388042E-03	0.821395E 01
0.635	0.50	18.0000	0.0006352	0.0002601	0.2742E 07	0.5218E 07	0.6883	0.1000E 01	0.377924E-03	0.333131E-03	0.134461E 02
0.776	0.50	15.0000	0.0005293	0.0002168	0.3351E 07	0.6377E 07	0.6883	0.1000E 01	0.314937E-03	0.301350E-03	0.450866E 01
0.924	0.50	15.0000	0.0005293	0.0002168	0.3990E 07	0.7593E 07	0.6883	0.1000E 01	0.314937E-03	0.276163E-03	0.140401E 02

Table 1. Continued

REENTRY F LAM. DATA. ALT EQUAL 135000 FT. ZERO DEG. RAY. ALPHA EQUAL .10 DEG.

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1884E 02	0.4588E 03	0.6610E 03	0.2001E-01	0.4967E 07	0.5000E 01	0.1305E 02	0.1405E 02	0.1350E 06	0.1979E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.5143E 01	0.5213E 01	0.1773E 01	0.9929E 00	0.2919E 01	0.9456E 07

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.103	0.50	50.0000	0.0015484	0.0006316	0.5116E 06	0.9740E 06	0.6875	0.1000E 01	0.918657E-03	0.771094E-03	0.191368E 02
0.199	0.50	49.0000	0.0015174	0.0006189	0.9885E 06	0.1882E 07	0.6875	0.1000E 01	0.900283E-03	0.554753E-03	0.622854E 02
0.257	0.50	32.0000	0.0009910	0.0004042	0.1277E 07	0.2430E 07	0.6875	0.1000E 01	0.587940E-03	0.488157E-03	0.204408E 02
0.334	0.50	30.0000	0.0009290	0.0003789	0.1659E 07	0.3158E 07	0.6875	0.1000E 01	0.551193E-03	0.428206E-03	0.287216E 02
0.380	0.50	29.0000	0.0008981	0.0003663	0.1888E 07	0.3593E 07	0.6875	0.1000E 01	0.532821E-03	0.401453E-03	0.327231E 02
0.468	0.50	27.0000	0.0008361	0.0003410	0.2325E 07	0.4426E 07	0.6875	0.1000E 01	0.496074E-03	0.361745E-03	0.371335E 02
0.545	0.50	25.0000	0.0007742	0.0003158	0.2707E 07	0.5154E 07	0.6875	0.1000E 01	0.459328E-03	0.335218E-03	0.370236E 02
0.635	0.50	22.0000	0.0006813	0.0002779	0.3154E 07	0.6005E 07	0.6875	0.1000E 01	0.404209E-03	0.310556E-03	0.301566E 02
0.699	0.50	20.0000	0.0006194	0.0002526	0.3472E 07	0.6610E 07	0.6875	0.1000E 01	0.367462E-03	0.295997E-03	0.241440E 02
0.776	0.50	19.0000	0.0005884	0.0002400	0.3855E 07	0.7338E 07	0.6875	0.1000E 01	0.349090E-03	0.280928E-03	0.242630E 02
0.853	0.50	20.0000	0.0006194	0.0002526	0.4237E 07	0.8066E 07	0.6875	0.1000E 01	0.367462E-03	0.267948E-03	0.371392E 02
0.924	0.50	20.0000	0.0006194	0.0002526	0.4590E 07	0.8738E 07	0.6875	0.1000E 01	0.367462E-03	0.257448E-03	0.427325E 02

REENTRY F LAM. DATA. ALT. EQUAL 135000 FT. 180 DEG. RAY. ALPHA EQUAL .10 DEG.

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1884E 02	0.4588E 03	0.6400E 03	0.1938E-01	0.4967E 07	0.5000E 01	0.1305E 02	0.1405E 02	0.1350E 06	0.1979E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.5143E 01	0.5213E 01	0.1773E 01	0.9929E 00	0.2919E 01	0.9456E 07

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.334	0.50	23.0000	0.0007118	0.0002903	0.1659E 07	0.3158E 07	0.6877	0.1000E 01	0.422136E-03	0.428206E-03	-0.141746E 01
0.468	0.50	20.0000	0.0006190	0.0002524	0.2325E 07	0.4426E 07	0.6877	0.1000E 01	0.367075E-03	0.361745E-03	0.147327E 01
0.635	0.50	17.0000	0.0005261	0.0002146	0.3154E 07	0.6005E 07	0.6877	0.1000E 01	0.312014E-03	0.310556E-03	0.469551E 00
0.776	0.50	15.0000	0.0004642	0.0001893	0.3855E 07	0.7338E 07	0.6877	0.1000E 01	0.275306E-03	0.280928E-03	-0.200112E 01
0.924	0.50	14.0000	0.0004333	0.0001767	0.4590E 07	0.8738E 07	0.6877	0.1000E 01	0.256952E-03	0.257448E-03	-0.192633E 00

Table 1. Continued

REENTRY F LAM. DATA. ALT EQUAL 130000 FT. ZERO DEG. RAY. ALPHA EQUAL .10 DEG.

MINF	TINF(R)	TW(R)	TW/TO	REINFL5	THETA(DEG)	L5(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1902E 02	0.4502E 03	0.6730E 03	0.2038E-01	0.6303E 07	0.5000E 01	0.1305E 02	0.1413E 02	0.1300E 06	0.1979E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REEL5
0.6308E 01	0.5289E 01	0.1785E 01	0.9927E 00	0.2941E 01	0.1200E 08

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.103	0.50	55.0000	0.0013637	0.0005523	0.6492E 06	0.1236E 07	0.6863	0.1000E 01	0.804717E-03	0.684418E-03	0.175769E 02
0.199	0.50	40.0000	0.0009918	0.0004016	0.1254E 07	0.2389E 07	0.6863	0.1000E 01	0.585249E-03	0.492395E-03	0.188576E 02
0.257	0.50	35.0000	0.0008678	0.0003514	0.1620E 07	0.3085E 07	0.6863	0.1000E 01	0.512093E-03	0.433285E-03	0.181885E 02
0.334	0.50	32.0000	0.0007934	0.0003213	0.2105E 07	0.4009E 07	0.6863	0.1000E 01	0.468199E-03	0.380073E-03	0.231867E 02
0.380	0.50	30.0000	0.0007438	0.0003012	0.2395E 07	0.4561E 07	0.6863	0.1000E 01	0.438937E-03	0.356326E-03	0.231838E 02
0.468	0.50	27.0000	0.0006695	0.0002711	0.2950E 07	0.5617E 07	0.6863	0.1000E 01	0.395043E-03	0.321083E-03	0.230347E 02
0.545	0.50	25.0000	0.0006199	0.0002510	0.3435E 07	0.6542E 07	0.6863	0.1000E 01	0.365780E-03	0.297537E-03	0.229360E 02
0.635	0.50	21.0000	0.0005207	0.0002109	0.4002E 07	0.7622E 07	0.6863	0.1000E 01	0.307256E-03	0.275647E-03	0.114671E 02
0.699	0.50	20.0000	0.0004959	0.0002008	0.4405E 07	0.8390E 07	0.6863	0.1000E 01	0.292624E-03	0.262725E-03	0.113806E 02
0.776	0.50	19.0000	0.0004711	0.0001908	0.4891E 07	0.9314E 07	0.6863	0.1000E 01	0.277993E-03	0.249350E-03	0.114870E 02
0.853	0.50	19.0000	0.0004711	0.0001908	0.5376E 07	0.1024E 08	0.6863	0.1000E 01	0.277993E-03	0.237830E-03	0.168872E 02
0.924	0.50	18.0000	0.0004463	0.0001807	0.5824E 07	0.1109E 08	0.6863	0.1000E 01	0.263362E-03	0.228510E-03	0.152519E 02

REENTRY F LAM. DATA. ALT. EQUAL 130000 FT. 180 DEG. RAY. ALPHA EQUAL .10 DEG.

MINF	TINF(R)	TW(R)	TW/TO	REINFL5	THETA(DEG)	L5(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1902E 02	0.4502E 03	0.6480E 03	0.1962E-01	0.6303E 07	0.5000E 01	0.1305E 02	0.1413E 02	0.1300E 06	0.1979E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REEL5
0.6308E 01	0.5289E 01	0.1785E 01	0.9927E 00	0.2941E 01	0.1200E 08

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.334	0.50	23.0000	0.0005698	0.0002307	0.2105E 07	0.4009E 07	0.6865	0.1000E 01	0.336095E-03	0.380073E-03	-0.115708E 02
0.468	0.50	20.0000	0.0004955	0.0002006	0.2950E 07	0.5617E 07	0.6865	0.1000E 01	0.292257E-03	0.321083E-03	-0.897770E 01
0.635	0.50	19.0000	0.0004707	0.0001906	0.4002E 07	0.7622E 07	0.6865	0.1000E 01	0.277644E-03	0.275647E-03	0.724473E 00
0.776	0.50	15.0000	0.0003716	0.0001505	0.4891E 07	0.9314E 07	0.6865	0.1000E 01	0.219193E-03	0.249350E-03	-0.120945E 02
0.924	0.50	15.0000	0.0003716	0.0001505	0.5824E 07	0.1109E 08	0.6865	0.1000E 01	0.219193E-03	0.228510E-03	-0.407737E 01

Table 1. Continued

REENTRY F LAM. DATA. ALT EQUAL 125000 FT. ZERO DEG. RAY. ALPHA EQUAL .10 DEG.

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1920E 02	0.4418E 03	0.6800E 03	0.2060E-01	0.8034E 07	0.5000E 01	0.1305E 02	0.1421E 02	0.1250E 06	0.1979E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.7770E 01	0.5366E 01	0.1798E 01	0.9925E 00	0.2962E 01	0.1530E 08

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.103	0.50	68.0000	0.0013439	0.0005403	0.8275E 06	0.1576E 07	0.6851	0.1000E 01	0.788673E-03	0.606131E-03	0.301160E 02
0.199	0.50	47.0000	0.0009289	0.0003735	0.1599E 07	0.3045E 07	0.6851	0.1000E 01	0.545112E-03	0.436072E-03	0.250050E 02
0.257	0.50	42.0000	0.0008300	0.0003337	0.2065E 07	0.3933E 07	0.6851	0.1000E 01	0.487121E-03	0.383723E-03	0.269459E 02
0.334	0.50	38.0000	0.0007510	0.0003020	0.2683E 07	0.5111E 07	0.6851	0.1000E 01	0.440729E-03	0.336598E-03	0.309362E 02
0.380	0.50	35.0000	0.0006917	0.0002781	0.3053E 07	0.5815E 07	0.6851	0.1000E 01	0.405934E-03	0.315568E-03	0.286360E 02
0.468	0.50	31.0000	0.0006127	0.0002463	0.3760E 07	0.7162E 07	0.6851	0.1000E 01	0.359542E-03	0.284356E-03	0.264409E 02
0.545	0.50	30.0000	0.0005929	0.0002384	0.4378E 07	0.8341E 07	0.6851	0.1000E 01	0.347944E-03	0.263504E-03	0.320452E 02
0.635	0.50	27.0000	0.0005336	0.0002145	0.5101E 07	0.9718E 07	0.6851	0.1000E 01	0.313149E-03	0.244118E-03	0.282781E 02
0.699	0.50	26.0000	0.0005138	0.0002066	0.5616E 07	0.1070E 08	0.6851	0.1000E 01	0.301551E-03	0.232674E-03	0.296025E 02
0.776	0.50	20.0000	0.0003953	0.0001589	0.6234E 07	0.1188E 08	0.6851	0.1000E 01	0.231963E-03	0.220828E-03	0.504219E 01
0.853	0.50	22.0000	0.0004348	0.0001748	0.6853E 07	0.1305E 08	0.6851	0.1000E 01	0.255159E-03	0.210626E-03	0.211433E 02
0.924	0.50	20.0000	0.0003953	0.0001589	0.7423E 07	0.1414E 08	0.6851	0.1000E 01	0.231963E-03	0.202371E-03	0.146223E 02

REENTRY F LAM. DATA. ALT. EQUAL 125000 FT. 180 DEG. RAY. ALPHA EQUAL .10 DEG.

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1920E 02	0.4418E 03	0.6510E 03	0.1972E-01	0.8034E 07	0.5000E 01	0.1305E 02	0.1421E 02	0.1250E 06	0.1979E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.7770E 01	0.5366E 01	0.1798E 01	0.9925E 00	0.2962E 01	0.1530E 08

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.334	0.50	30.0000	0.0005924	0.0002381	0.2683E 07	0.5111E 07	0.6854	0.1000E 01	0.347436E-03	0.336598E-03	0.321987E 01
0.468	0.50	22.0000	0.0004344	0.0001746	0.3760E 07	0.7162E 07	0.6854	0.1000E 01	0.254787E-03	0.284356E-03	-0.103986E 02
0.635	0.50	20.0000	0.0003949	0.0001588	0.5101E 07	0.9718E 07	0.6854	0.1000E 01	0.231624E-03	0.244118E-03	-0.511773E 01
0.776	0.50	18.0000	0.0003554	0.0001429	0.6234E 07	0.1188E 08	0.6854	0.1000E 01	0.208462E-03	0.220828E-03	-0.559992E 01
0.924	0.50	17.0000	0.0003357	0.0001349	0.7423E 07	0.1414E 08	0.6854	0.1000E 01	0.196881E-03	0.202371E-03	-0.271316E 01

Table 1. Continued

REENTRY F LAM. DATA. ALT EQUAL 120000 FT. ZERO DEG. RAY. ALPHA EQUAL .10 DEG.

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1937E 02	0.4338E 03	0.6940E 03	0.2104E-01	0.1027E 08	0.5000E 01	0.1305E 02	0.1429E 02	0.1200E 06	0.1979E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.9610E 01	0.5440E 01	0.1810E 01	0.9923E 00	0.2982E 01	0.1956E 08

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTRDE	EDGE PARA	T.E.P.	P.E.
0.103	0.50	69.0000	0.0010839	0.0004328	0.1058E 07	0.2015E 07	0.6840	0.1000E 01	0.632846E-03	0.536109E-03	0.180442E 02
0.199	0.50	55.0000	0.0008640	0.0003450	0.2043E 07	0.3893E 07	0.6840	0.1000E 01	0.504442E-03	0.385696E-03	0.307875E 02
0.257	0.50	45.0000	0.0007069	0.0002823	0.2639E 07	0.5028E 07	0.6840	0.1000E 01	0.412726E-03	0.339394E-03	0.216065E 02
0.334	0.50	38.0000	0.0005969	0.0002384	0.3430E 07	0.6534E 07	0.6840	0.1000E 01	0.348524E-03	0.297713E-03	0.170669E 02
0.380	0.50	35.0000	0.0005498	0.0002196	0.3902E 07	0.7434E 07	0.6840	0.1000E 01	0.321009E-03	0.279113E-03	0.150104E 02
0.468	0.50	32.0000	0.0005027	0.0002007	0.4806E 07	0.9155E 07	0.6840	0.1000E 01	0.293494E-03	0.251507E-03	0.166939E 02
0.545	0.50	30.0000	0.0004713	0.0001882	0.5596E 07	0.1066E 08	0.6840	0.1000E 01	0.275150E-03	0.233063E-03	0.180584E 02
0.635	0.50	29.0000	0.0004555	0.0001819	0.6521E 07	0.1242E 08	0.6840	0.1000E 01	0.265979E-03	0.215917E-03	0.231858E 02
0.699	0.50	25.0000	0.0003927	0.0001568	0.7178E 07	0.1367E 08	0.6840	0.1000E 01	0.229292E-03	0.205795E-03	0.114176E 02
0.776	0.50	25.0000	0.0003927	0.0001568	0.7968E 07	0.1518E 08	0.6840	0.1000E 01	0.229292E-03	0.195318E-03	0.173944E 02
0.853	0.50	22.0000	0.0003456	0.0001380	0.8759E 07	0.1669E 08	0.6840	0.1000E 01	0.201777E-03	0.186294E-03	0.831116E 01
0.924	0.50	21.0000	0.0003299	0.0001317	0.9488E 07	0.1808E 08	0.6840	0.1000E 01	0.192605E-03	0.178993E-03	0.760493E 01

REENTRY F LAM. DATA. ALT. EQUAL 120000 FT. 180 DEG. RAY. ALPHA EQUAL .10 DEG.

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1937E 02	0.4338E 03	0.6590E 03	0.1997E-01	0.1027E 08	0.5000E 01	0.1305E 02	0.1429E 02	0.1200E 06	0.1979E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.9610E 01	0.5440E 01	0.1810E 01	0.9923E 00	0.2982E 01	0.1956E 08

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTRDE	EDGE PARA	T.E.P.	P.E.
0.334	0.50	34.0000	0.0005335	0.0002130	0.3430E 07	0.6534E 07	0.6843	0.1000E 01	0.311288E-03	0.297713E-03	0.455958E 01
0.468	0.50	28.0000	0.0004394	0.0001754	0.4806E 07	0.9155E 07	0.6843	0.1000E 01	0.256355E-03	0.251507E-03	0.192730E 01
0.635	0.50	25.0000	0.0003923	0.0001566	0.6521E 07	0.1242E 08	0.6843	0.1000E 01	0.228888E-03	0.215917E-03	0.600760E 01
0.776	0.50	22.0000	0.0003452	0.0001378	0.7968E 07	0.1518E 08	0.6843	0.1000E 01	0.201422E-03	0.195318E-03	0.312512E 01
0.924	0.50	22.0000	0.0003452	0.0001378	0.9488E 07	0.1808E 08	0.6843	0.1000E 01	0.201422E-03	0.178993E-03	0.125304E 02

Table 1. Continued

REENTRY F LAM. OATA. ALT EQUAL 115000 FT. ZERO OEG. RAY. ALPHA EUQAL .08 DEG.

MINF	TINF(R)	TW(R)	TW/TO	REINFL5	THETA(OEG)	L5(FT)	ME	ALT(FT)	UINF(FT/5EC)
0.1953E 02	0.4265E 03	0.7020E 03	0.2129E-01	0.1312E 08	0.5000E 01	0.1305E 02	0.1436E 02	0.1150E 06	0.1978E 05

PINF(P5F)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REEL5
0.1191E 02	0.5510E 01	0.1822E 01	0.9921E 00	0.3001E 01	0.2500E 08

EXPERIMENTAL OATA

X/L	N	QOOT	5TINF	5TEAW	REINFL	REEL	C5TAREN	R05TROE	EDGE PARA	T.E.P.	P.E.
0.103	0.50	65.0000	0.0008110	0.0003219	0.1351E 07	0.2575E 07	0.6830	0.1000E 01	0.471252E-03	0.474278E-03	-0.638043E 00
0.199	0.50	58.0000	0.0007236	0.0002872	0.2611E 07	0.4974E 07	0.6830	0.1000E 01	0.420502E-03	0.341213E-03	0.232373E 02
0.257	0.50	49.0000	0.0006113	0.0002426	0.3372E 07	0.6424E 07	0.6830	0.1000E 01	0.355252E-03	0.300252E-03	0.183179E 02
0.334	0.50	40.0000	0.0004991	0.0001981	0.4382E 07	0.8349E 07	0.6830	0.1000E 01	0.290001E-03	0.263377E-03	0.101087E 02
0.380	0.50	39.0000	0.0004866	0.0001931	0.4986E 07	0.9498E 07	0.6830	0.1000E 01	0.282751E-03	0.246923E-03	0.145097E 02
0.468	0.50	36.0000	0.0004492	0.0001783	0.6141E 07	0.1170E 08	0.6830	0.1000E 01	0.261001E-03	0.222501E-03	0.173035E 02
0.545	0.50	32.0000	0.0003992	0.0001585	0.7151E 07	0.1362E 08	0.6830	0.1000E 01	0.232001E-03	0.206183E-03	0.125218E 02
0.635	0.50	30.0000	0.0003743	0.0001485	0.8332E 07	0.1587E 08	0.6830	0.1000E 01	0.217501E-03	0.191015E-03	0.138662E 02
0.699	0.50	28.0000	0.0003493	0.0001386	0.9172E 07	0.1747E 08	0.6830	0.1000E 01	0.203001E-03	0.182060E-03	0.115021E 02
0.776	0.50	27.0000	0.0003369	0.0001337	0.1018E 08	0.1940E 08	0.6830	0.1000E 01	0.195751E-03	0.172791E-03	0.132876E 02
0.853	0.50	26.0000	0.0003244	0.0001287	0.1119E 08	0.2132E 08	0.6830	0.1000E 01	0.188501E-03	0.164808E-03	0.143760E 02
0.924	0.50	25.0000	0.0003119	0.0001238	0.1212E 08	0.2310E 08	0.6830	0.1000E 01	0.181251E-03	0.158349E-03	0.144626E 02

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REENTRY F LAM. DATA. ALT. EQUAL 115000 FT. 180 OEG. RAY. ALPHA EQUAL .08 DEG.

MINF	TINF(R)	TW(R)	TW/TO	REINFL5	THETA(DEG)	L5(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1953E 02	0.4265E 03	0.6700E 03	0.2032E-01	0.1312E 08	0.5000E 01	0.1305E 02	0.1436E 02	0.1150E 06	0.1978E 05

PINF(P5F)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REEL5
0.1191E 02	0.5510E 01	0.1822E 01	0.9921E 00	0.3001E 01	0.2500E 08

EXPERIMENTAL DATA

X/L	N	QDOT	5TINF	5TEAW	REINFL	REEL	C5TAREN	R05TROE	EOGE PARA	T.E.P.	P.E.
0.334	0.50	40.0000	0.0004986	0.0001978	0.4382E 07	0.8349E 07	0.6833	0.1000E 01	0.289534E-03	0.263377E-03	0.993116E 01
0.468	0.50	36.0000	0.0004487	0.0001780	0.6141E 07	0.1170E 08	0.6833	0.1000E 01	0.260580E-03	0.222501E-03	0.171144E 02
0.635	0.50	28.0000	0.0003490	0.0001385	0.8332E 07	0.1587E 08	0.6833	0.1000E 01	0.202674E-03	0.191015E-03	0.610383E 01
0.776	0.50	27.0000	0.0003365	0.0001335	0.1018E 08	0.1940E 08	0.6833	0.1000E 01	0.195435E-03	0.172791E-03	0.131050E 02
0.924	0.50	25.0000	0.0003116	0.0001236	0.1212E 08	0.2310E 08	0.6833	0.1000E 01	0.180959E-03	0.158349E-03	0.142781E 02

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Table 1. Continued

REENTRY F LAM. DATA. ALT EQUAL 110000 FT. ZERO DEG. RAY. ALPHA EQUAL .08 DEG.

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1967E 02	0.4201E 03	0.7150E 03	0.2171E-01	0.1681E 08	0.5000E 01	0.1305E 02	0.1442E 02	0.1100E 06	0.1977E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.1484E 02	0.5572E 01	0.1832E 01	0.9920E 00	0.3018E 01	0.3201E 08

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.103	0.50	85.0000	0.0008395	0.0003314	0.1731E 07	0.3297E 07	0.6821	0.1000E 01	0.485836E-03	0.419115E-03	0.159193E 02
0.199	0.50	63.0000	0.0006222	0.0002456	0.3344E 07	0.6370E 07	0.6821	0.1000E 01	0.360090E-03	0.301526E-03	0.194224E 02
0.257	0.50	55.0000	0.0005432	0.0002144	0.4319E 07	0.8226E 07	0.6821	0.1000E 01	0.314364E-03	0.265329E-03	0.184808E 02
0.334	0.50	46.0000	0.0004543	0.0001793	0.5613E 07	0.1069E 08	0.6821	0.1000E 01	0.262923E-03	0.232745E-03	0.129661E 02
0.380	0.50	45.0000	0.0004444	0.0001754	0.6386E 07	0.1216E 08	0.6821	0.1000E 01	0.257207E-03	0.218204E-03	0.178749E 02
0.468	0.50	40.0000	0.0003951	0.0001559	0.7865E 07	0.1498E 08	0.6821	0.1000E 01	0.228629E-03	0.196621E-03	0.162786E 02
0.545	0.50	39.0000	0.0003852	0.0001520	0.9159E 07	0.1744E 08	0.6821	0.1000E 01	0.222913E-03	0.182203E-03	0.223430E 02
0.635	0.50	35.0000	0.0003457	0.0001364	0.1067E 08	0.2033E 08	0.6821	0.1000E 01	0.200050E-03	0.168798E-03	0.185148E 02
0.699	0.50	35.0000	0.0003457	0.0001364	0.1175E 08	0.2237E 08	0.6821	0.1000E 01	0.200050E-03	0.160885E-03	0.243437E 02
0.776	0.50	29.0000	0.0002864	0.0001131	0.1304E 08	0.2484E 08	0.6821	0.1000E 01	0.165756E-03	0.152694E-03	0.855444E 01
0.853	0.50	29.0000	0.0002864	0.0001131	0.1433E 08	0.2730E 08	0.6821	0.1000E 01	0.165756E-03	0.145639E-03	0.138127E 02
0.924	0.50	29.0000	0.0002864	0.0001131	0.1553E 08	0.2958E 08	0.6821	0.1000E 01	0.165756E-03	0.139932E-03	0.184548E 02

REENTRY F LAM. DATA. ALT. EQUAL 110000 FT. 180 DEG. RAY. ALPHA EQUAL .08 DEG.

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1967E 02	0.4201E 03	0.6780E 03	0.2058E-01	0.1681E 08	0.5000E 01	0.1305E 02	0.1442E 02	0.1100E 06	0.1977E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.1484E 02	0.5572E 01	0.1832E 01	0.9920E 00	0.3018E 01	0.3201E 08

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.334	0.50	44.0000	0.0004341	0.0001713	0.5613E 07	0.1069E 08	0.6824	0.1000E 01	0.251022E-03	0.232745E-03	0.785290E 01
0.468	0.50	40.0000	0.0003946	0.0001557	0.7865E 07	0.1498E 08	0.6824	0.1000E 01	0.228202E-03	0.196621E-03	0.160617E 02
0.635	0.50	31.0000	0.0003058	0.0001207	0.1067E 08	0.2033E 08	0.6824	0.1000E 01	0.176857E-03	0.168798E-03	0.477444E 01
0.776	0.50	25.0000	0.0002466	0.0000973	0.1304E 08	0.2484E 08	0.6824	0.1000E 01	0.142626E-03	0.152694E-03	-0.659320E 01
0.924	0.50	25.0000	0.0002466	0.0000973	0.1553E 08	0.2958E 08	0.6824	0.1000E 01	0.142626E-03	0.139932E-03	0.192568E 01

Table 1. Continued

REENTRY F LAM. DATA. ALT EQUAL 105000 FT. ZERO DEG. RAY. ALPHA EQUAL .08 DEG.

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1979E 02	0.4145E 03	0.7320E 03	0.2225E-01	0.2151E 08	0.5000E 01	0.1305E 02	0.1447E 02	0.1050E 06	0.1976E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	RDUE/RDUINF	REELS
0.1856E 02	0.5625E 01	0.1840E 01	0.9918E 00	0.3032E 01	0.4096E 08

EXPERIMENTAL DATA

X/L	N	QDDT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTRDE	EDGE PARA	T.E.P.	P.E.
0.103	0.50	96.0000	0.0007502	0.0002948	0.2216E 07	0.4219E 07	0.6813	0.1000E 01	0.432720E-03	0.370489E-03	0.167969E 02
0.199	0.50	68.0000	0.0005314	0.0002088	0.4281E 07	0.8151E 07	0.6813	0.1000E 01	0.306510E-03	0.266543E-03	0.149946E 02
0.257	0.50	61.0000	0.0004767	0.0001873	0.5528E 07	0.1053E 08	0.6813	0.1000E 01	0.274958E-03	0.234547E-03	0.172291E 02
0.334	0.50	53.0000	0.0004142	0.0001628	0.7185E 07	0.1368E 08	0.6813	0.1000E 01	0.238898E-03	0.205742E-03	0.161153E 02
0.380	0.50	50.0000	0.0003907	0.0001535	0.8174E 07	0.1557E 08	0.6813	0.1000E 01	0.225375E-03	0.192888E-03	0.168428E 02
0.468	0.50	47.0000	0.0003673	0.0001443	0.1007E 08	0.1917E 08	0.6813	0.1000E 01	0.211853E-03	0.173809E-03	0.218880E 02
0.545	0.50	42.0000	0.0003282	0.0001290	0.1172E 08	0.2232E 08	0.6813	0.1000E 01	0.189315E-03	0.161064E-03	0.175403E 02
0.635	0.50	38.0000	0.0002970	0.0001167	0.1366E 08	0.2601E 08	0.6813	0.1000E 01	0.171285E-03	0.149214E-03	0.147920E 02
0.699	0.50	36.0000	0.0002813	0.0001105	0.1504E 08	0.2863E 08	0.6813	0.1000E 01	0.162270E-03	0.142219E-03	0.140989E 02
0.776	0.50	38.0000	0.0002970	0.0001167	0.1669E 08	0.3179E 08	0.6813	0.1000E 01	0.171285E-03	0.134978E-03	0.268984E 02
0.853	0.50	33.0000	0.0002579	0.0001013	0.1835E 08	0.3494E 08	0.6813	0.1000E 01	0.148748E-03	0.128742E-03	0.155393E 02

REENTRY F LAM. DATA. ALT. EQUAL 105000 FT. 180 DEG. RAY. ALPHA EQUAL .08 DEG.

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1979E 02	0.4145E 03	0.6950E 03	0.2113E-01	0.2151E 08	0.5000E 01	0.1305E 02	0.1447E 02	0.1050E 06	0.1976E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	RDUE/RDUINF	REELS
0.1856E 02	0.5625E 01	0.1840E 01	0.9918E 00	0.3032E 01	0.4096E 08

EXPERIMENTAL DATA

X/L	N	QDDT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.334	0.50	48.0000	0.0003747	0.0001472	0.7185E 07	0.1368E 08	0.6816	0.1000E 01	0.215956E-03	0.205742E-03	0.496456E 01
0.468	0.50	49.0000	0.0003825	0.0001503	0.1007E 08	0.1917E 08	0.6816	0.1000E 01	0.220455E-03	0.173809E-03	0.268373E 02
0.635	0.50	37.0000	0.0002888	0.0001135	0.1366E 08	0.2601E 08	0.6816	0.1000E 01	0.166466E-03	0.149214E-03	0.115623E 02
0.776	0.50	36.0000	0.0002810	0.0001104	0.1669E 08	0.3179E 08	0.6816	0.1000E 01	0.161967E-03	0.134978E-03	0.199949E 02

Table 1. Continued

REENTRY F LAM. DATA. ALT EQUAL 100000 FT. ZERO DEG. RAY. ALPHA EQUAL .08 DEG.

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1989E 02	0.4098E 03	0.7610E 03	0.2317E-01	0.2750E 08	0.5000E 01	0.1305E 02	0.1451E 02	0.1000E 06	0.1975E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.2325E 02	0.5669E 01	0.1847E 01	0.9917E 00	0.3043E 01	0.5235E 08

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.103	0.50	100.0000	0.0006187	0.0002423	0.2833E 07	0.5392E 07	0.6805	0.1000E 01	0.356027E-03	0.327723E-03	0.863673E 01
0.199	0.50	76.0000	0.0004702	0.0001841	0.5473E 07	0.1042E 08	0.6805	0.1000E 01	0.270581E-03	0.235776E-03	0.147617E 02
0.257	0.50	65.0000	0.0004022	0.0001575	0.7068E 07	0.1345E 08	0.6805	0.1000E 01	0.231418E-03	0.207472E-03	0.115414E 02
0.334	0.50	60.0000	0.0003712	0.0001454	0.9185E 07	0.1748E 08	0.6805	0.1000E 01	0.213616E-03	0.181992E-03	0.173766E 02
0.380	0.50	51.0000	0.0003156	0.0001236	0.1045E 08	0.1989E 08	0.6805	0.1000E 01	0.181574E-03	0.170622E-03	0.641894E 01
0.468	0.50	49.0000	0.0003032	0.0001187	0.1287E 08	0.2450E 08	0.6805	0.1000E 01	0.174453E-03	0.153746E-03	0.134687E 02
0.545	0.50	45.0000	0.0002784	0.0001090	0.1499E 08	0.2853E 08	0.6805	0.1000E 01	0.160212E-03	0.142472E-03	0.124519E 02
0.635	0.50	40.0000	0.0002475	0.0000969	0.1746E 08	0.3324E 08	0.6805	0.1000E 01	0.142411E-03	0.131989E-03	0.789588E 01
0.699	0.50	38.0000	0.0002351	0.0000921	0.1922E 08	0.3659E 08	0.6805	0.1000E 01	0.135290E-03	0.125802E-03	0.754237E 01

REENTRY F LAM. DATA. ALT. EQUAL 100000 FT. 180 DEG. RAY. ALPHA EQUAL .08 DEG.

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1989E 02	0.4098E 03	0.7140E 03	0.2174E-01	0.2750E 08	0.5000E 01	0.1305E 02	0.1451E 02	0.1000E 06	0.1975E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.2325E 02	0.5669E 01	0.1847E 01	0.9917E 00	0.3043E 01	0.5235E 08

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.334	0.50	50.0000	0.0003089	0.0001209	0.9185E 07	0.1748E 08	0.6809	0.1000E 01	0.177590E-03	0.181992E-03	-0.241872E 01
0.468	0.50	45.0000	0.0002780	0.0001088	0.1287E 08	0.2450E 08	0.6809	0.1000E 01	0.159831E-03	0.153746E-03	0.395815E 01
0.635	0.50	39.0000	0.0002410	0.0000943	0.1746E 08	0.3324E 08	0.6809	0.1000E 01	0.138520E-03	0.131989E-03	0.494833E 01

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Table 1. Continued

REENTRY F LAM. DATA. ALT EQUAL 95000 FT. ZERO DEG. RAY. ALPHA EQUAL .08 DEG.

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1997E 02	0.4058E 03	0.7680E 03	0.2344E-01	0.3514E 08	0.5000E 01	0.1305E 02	0.1455E 02	0.9500E 05	0.1972E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.2921E 02	0.5702E 01	0.1853E 01	0.9916E 00	0.3052E 01	0.6686E 08

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.103	0.50	120.0000	0.0005875	0.0002294	0.3619E 07	0.6887E 07	0.6801	0.1000E 01	0.337305E-03	0.289988E-03	0.163165E 02
0.199	0.50	92.0000	0.0004504	0.0001759	0.6993E 07	0.1331E 08	0.6801	0.1000E 01	0.258600E-03	0.208628E-03	0.239527E 02
0.257	0.50	75.0000	0.0003672	0.0001434	0.9031E 07	0.1718E 08	0.6801	0.1000E 01	0.210815E-03	0.183583E-03	0.148335E 02
0.334	0.50	68.0000	0.0003329	0.0001300	0.1174E 08	0.2233E 08	0.6801	0.1000E 01	0.191139E-03	0.161038E-03	0.186918E 02
0.380	0.50	65.0000	0.0003182	0.0001243	0.1335E 08	0.2541E 08	0.6801	0.1000E 01	0.182707E-03	0.150976E-03	0.210171E 02
0.468	0.50	53.0000	0.0002595	0.0001013	0.1644E 08	0.3129E 08	0.6801	0.1000E 01	0.148976E-03	0.136043E-03	0.950669E 01
0.545	0.50	52.0000	0.0002546	0.0000994	0.1915E 08	0.3644E 08	0.6801	0.1000E 01	0.146165E-03	0.126067E-03	0.159424E 02
0.635	0.50	53.0000	0.0002595	0.0001013	0.2231E 08	0.4246E 08	0.6801	0.1000E 01	0.148976E-03	0.116792E-03	0.275563E 02

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REENTRY F LAM. DATA. ALT. EQUAL 95000 FT. 180 DEG. RAY. ALPHA EQUAL .08 DEG.

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1997E 02	0.4058E 03	0.7300E 03	0.2228E-01	0.3514E 08	0.5000E 01	0.1305E 02	0.1455E 02	0.9500E 05	0.1972E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.2921E 02	0.5702E 01	0.1853E 01	0.9916E 00	0.3052E 01	0.6686E 08

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.334	0.50	57.0000	0.0002787	0.0001088	0.1174E 08	0.2233E 08	0.6804	0.1000E 01	0.159911E-03	0.161038E-03	-0.700088E 00
0.468	0.50	50.0000	0.0002445	0.0000954	0.1644E 08	0.3129E 08	0.6804	0.1000E 01	0.140273E-03	0.136043E-03	0.310907E 01
0.635	0.50	52.0000	0.0002543	0.0000993	0.2231E 08	0.4246E 08	0.6804	0.1000E 01	0.145884E-03	0.116792E-03	0.249084E 02

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Table 1. Continued

REENTRY F LAM. DATA. ALT EQUAL 90000 FT. ZERO DEG. RAY. ALPHA EQUAL .10 DEG.

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.2002E 02	0.4022E 03	0.8420E 03	0.2580E-01	0.4507E 08	0.5000E 01	0.1305E 02	0.1457E 02	0.9000E 05	0.1969E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.3694E 02	0.5725E 01	0.1857E 01	0.9916E 00	0.3058E 01	0.8572E 08

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.103	0.50	130.0000	0.0005028	0.0001960	0.4643E 07	0.8829E 07	0.6792	0.1000E 01	0.288653E-03	0.256110E-03	0.127067E 02
0.199	0.50	98.0000	0.0003790	0.0001478	0.8970E 07	0.1706E 08	0.6792	0.1000E 01	0.217600E-03	0.184256E-03	0.180968E 02
0.257	0.50	82.0000	0.0003172	0.0001237	0.1158E 08	0.2203E 08	0.6792	0.1000E 01	0.182073E-03	0.162137E-03	0.122963E 02
0.334	0.50	75.0000	0.0002901	0.0001131	0.1505E 08	0.2863E 08	0.6792	0.1000E 01	0.166531E-03	0.142224E-03	0.170902E 02
0.380	0.50	68.0000	0.0002630	0.0001025	0.1713E 08	0.3257E 08	0.6792	0.1000E 01	0.150988E-03	0.133338E-03	0.132365E 02
0.468	0.50	60.0000	0.0002321	0.0000905	0.2109E 08	0.4012E 08	0.6792	0.1000E 01	0.133224E-03	0.120150E-03	0.108817E 02

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REENTRY F LAM. DATA. ALT. EQUAL 90000 FT. 180 DEG. RAY. ALPHA EQUAL .10 DEG.

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.2002E 02	0.4022E 03	0.7600E 03	0.2329E-01	0.4507E 08	0.5000E 01	0.1305E 02	0.1457E 02	0.9000E 05	0.1969E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.3694E 02	0.5725E 01	0.1857E 01	0.9916E 00	0.3058E 01	0.8572E 08

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.334	0.50	65.0000	0.0002508	0.0000977	0.1505E 08	0.2863E 08	0.6799	0.1000E 01	0.143724E-03	0.142224E-03	0.105473E 01
0.468	0.50	60.0000	0.0002315	0.0000902	0.2109E 08	0.4012E 08	0.6799	0.1000E 01	0.132669E-03	0.120150E-03	0.104191E 02

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Table 1. Concluded

REENTRY F LAM. DATA. ALT EQUAL 87000 FT. ZERO DEG. RAY. ALPHA EQUAL 0 DEG.

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.2004E 02	0.4003E 03	0.8750E 03	0.2689E-01	0.5232E 08	0.5000E 01	0.1305E 02	0.1458E 02	0.8700E 05	0.1966E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.4257E 02	0.5734E 01	0.1858E 01	0.9915E 00	0.3060E 01	0.9947E 08

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.103	0.50	135.0000	0.0004534	0.0001767	0.5389E 07	0.1025E 08	0.6788	0.1000E 01	0.260286E-03	0.237752E-03	0.947803E 01
0.199	0.50	102.0000	0.0003426	0.0001335	0.1041E 08	0.1979E 08	0.6788	0.1000E 01	0.196661E-03	0.171048E-03	0.149741E 02
0.257	0.50	87.0000	0.0002922	0.0001139	0.1345E 08	0.2556E 08	0.6788	0.1000E 01	0.167740E-03	0.150514E-03	0.114453E 02
0.334	0.50	76.0000	0.0002552	0.0000995	0.1748E 08	0.3322E 08	0.6788	0.1000E 01	0.146532E-03	0.132030E-03	0.109840E 02
0.380	0.50	69.0000	0.0002317	0.0000903	0.1988E 08	0.3780E 08	0.6788	0.1000E 01	0.133035E-03	0.123780E-03	0.747747E 01

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Table 2. Ground Facilities and Test Conditions for Laminar Data

Source	Ref.	M_∞	$Re_\infty \times 10^{-6}$/ft	T_o, °R	θ_c, deg	L_s, ft	$Re_e \times 10^{-6}$/ft	M_e	T_w/T_o	$(C_e^*)^{1/2}$
Princeton	16	17.9 - 26.2	~0.08 - 0.48	~3600	3.0	0.598	~0.27 - 0.71	~15 - 20	~0.15	~0.87
↓	↓	18.6 - 24.4	~0.09 - 0.48	↓	5.0	0.718	~0.15 - 0.79	~14 - 16	~0.16	~0.87
		18.1 - 24.7	~0.12 - 0.49		15.0	0.250	~0.06 - 0.37	~7	~0.17	~0.87
		17.7 - 24.9	~0.08 - 0.47		20.0	0.129	~0.03 - 0.26	~5	~0.15	~0.90
NOL	22	7.9	~6.2 - 9.2	~1450	5.0	2.008	~8.1 - 11.9	~7.2	~0.35	~0.95
↓	↓	↓	~9.3	↓	↓	↓	~12.1	↓	~0.32	↓
			↓				↓		~0.24	
									~0.20	
									~0.11	
Langley	24	6.8	~1.9 - 6.3	~1050	10.0	1.02	~2.9 - 9.8	~5.6	~0.52	~0.94
	24	6.8	~2.6 - 4.7	~1200	10.0	1.02	~3.9 - 7.2	~5.6	~0.46	~0.94
VKF-B	25, 26	8.0	~3.7	~1350	4.0	4.78	~4.5	~7.4	~0.36	~0.94
	25, 26	8.0	~1.4	~1250	7.2	3.61	~2.1	~6.8	~0.42	~0.94
VKF-C	27, 28, 29	10	~1.3	~2015	7.2	3.60	~2.1	~8.2	~0.27	~0.91
	↓	10	~1.5 - 2.1	~1900	8.0	2.99	~2.4 - 3.4	~8.1	~0.27	~0.91
		10	~0.61 - 0.97	~1980	10.0	1.67	~1.0 - 2.7	~7.4	~0.27	~0.91
VKF-F	28, 30	~16.1	~0.10	~7100*	5.0	1.67	~0.16	~12.7	~0.08*	~0.77
	28, 30	~10.5	~3.6 - 5.0	~2600*	6.3	1.71	~5.5 - 12.4	~8.8	~0.20*	~0.88
	28, 30	~17.0	~0.12 - 1.2	~5400*	10.0	1.67	~0.17 - 1.6	~9.3	~0.10*	~0.82
VKF-M	18	~18.2	~0.015	~5200*	10.0	0.96	~0.019	~9.5	~0.10	~0.84
	18	~18.6	~0.013	~4500*	10.0	0.96	~0.017	~9.6	~0.10	~0.84
	18	~19.9	~0.012	~4500*	10.0	0.96	~0.014	~9.8	~0.10	~0.84

*Using real gas relationships

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Table 3. Laminar Ground Facility Data

LAMINAR BOUNDARY LAYER DATA FROM PRINCETON N-3 AND N-5 TUNNELS

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.2620E 02	0.2600E 02	0.5400E 03	0.1502E 00	0.9908E 05	0.3000E 01	0.5980E 00	0.2061E 02	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.2450E-01	0.4011E 01	0.1574E 01	0.9872E 00	0.2515E 01	0.1583E 06

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.247	0.50	0.6574	0.0077500	0.0037800	0.2447E 05	0.3909E 05	0.8702	0.1000E 01	0.434401E-02	0.384885E-02	0.128652E 02
0.297	0.50	0.6069	0.0071554	0.0034900	0.2943E 05	0.4701E 05	0.8702	0.1000E 01	0.401074E-02	0.350995E-02	0.142676E 02
0.366	0.50	0.5391	0.0063558	0.0031000	0.3626E 05	0.5793E 05	0.8702	0.1000E 01	0.356255E-02	0.316183E-02	0.126736E 02
0.449	0.50	0.5009	0.0059048	0.0028800	0.4449E 05	0.7107E 05	0.8702	0.1000E 01	0.330972E-02	0.285467E-02	0.159405E 02
0.543	0.50	0.4400	0.0051872	0.0025300	0.5380E 05	0.8594E 05	0.8702	0.1000E 01	0.290750E-02	0.259585E-02	0.120057E 02
0.613	0.50	0.4052	0.0047771	0.0023300	0.6074E 05	0.9702E 05	0.8702	0.1000E 01	0.267766E-02	0.244314E-02	0.959891E 01
0.840	0.50	0.2939	0.0034649	0.0016900	0.8323E 05	0.1330E 06	0.8702	0.1000E 01	0.194216E-02	0.208708E-02	-0.694362E 01

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LAMINAR BOUNDARY LAYER DATA FROM PRINCETON N-3 AND N-5 TUNNELS

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1790E 02	0.5530E 02	0.5400E 03	0.1500E 00	0.1350E 06	0.3000E 01	0.5980E 00	0.1548E 02	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.1440E 00	0.2509E 01	0.1317E 01	0.9924E 00	0.1891E 01	0.1938E 06

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.235	0.50	1.0993	0.0047015	0.0030500	0.3172E 05	0.4554E 05	0.8674	0.1000E 01	0.351606E-02	0.356601E-02	-0.140091E 01
0.289	0.50	1.0813	0.0046245	0.0030000	0.3901E 05	0.5601E 05	0.8674	0.1000E 01	0.345842E-02	0.321565E-02	0.754968E 01
0.361	0.50	0.8939	0.0038229	0.0024800	0.4873E 05	0.6996E 05	0.8674	0.1000E 01	0.285896E-02	0.287716E-02	-0.632598E 00
0.439	0.50	0.7893	0.0033759	0.0021900	0.5926E 05	0.8507E 05	0.8674	0.1000E 01	0.252464E-02	0.260907E-02	-0.323569E 01
0.537	0.50	0.6956	0.0029751	0.0019300	0.7249E 05	0.1041E 06	0.8674	0.1000E 01	0.222491E-02	0.235901E-02	-0.568445E 01
0.604	0.50	0.6416	0.0027439	0.0017800	0.8153E 05	0.1171E 06	0.8674	0.1000E 01	0.205199E-02	0.222433E-02	-0.774771E 01
0.650	0.50	0.5911	0.0025280	0.0016400	0.8774E 05	0.1260E 06	0.8674	0.1000E 01	0.189060E-02	0.214418E-02	-0.118262E 02
0.722	0.50	0.5407	0.0023122	0.0015000	0.9746E 05	0.1399E 06	0.8674	0.1000E 01	0.172921E-02	0.203446E-02	-0.150040E 02

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Table 3. Continued

LAMINAR BOUNDARY LAYER DATA FROM PRINCETON N-3 AND N-5 TUNNELS

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1870E 02	0.4310E 02	0.5400E 03	0.1766E 00	0.2894E 06	0.3000E 01	0.5980E 00	0.1603E 02	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.2160E 00	0.2631E 01	0.1339E 01	0.9919E 00	0.1950E 01	0.4214E 06

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.247	0.50	1.0832	0.0031714	0.0020100	0.7147E 05	0.1041E 06	0.8837	0.1000E 01	0.227453E-02	0.235878E-02	-0.357158E 01
0.306	0.50	1.0724	0.0031398	0.0019900	0.8854E 05	0.1289E 06	0.8837	0.1000E 01	0.225190E-02	0.211921E-02	0.626109E 01
0.392	0.50	0.8299	0.0024298	0.0015400	0.1134E 06	0.1652E 06	0.8837	0.1000E 01	0.174268E-02	0.187238E-02	-0.692694E 01
0.581	0.50	0.6790	0.0019880	0.0012600	0.1681E 06	0.2448E 06	0.8837	0.1000E 01	0.142583E-02	0.153797E-02	-0.729163E 01
0.653	0.50	0.5874	0.0017198	0.0010900	0.1889E 06	0.2752E 06	0.8837	0.1000E 01	0.123345E-02	0.145070E-02	-0.149756E 02
0.759	0.50	0.5066	0.0014831	0.0009400	0.2196E 06	0.3198E 06	0.8837	0.1000E 01	0.106371E-02	0.134560E-02	-0.209486E 02
0.911	0.50	0.4904	0.0014358	0.0009100	0.2636E 06	0.3839E 06	0.8837	0.1000E 01	0.102976E-02	0.122822E-02	-0.161581E 02

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LAMINAR BOUNDARY LAYER DATA FROM PRINCETON N-3 AND N-5 TUNNELS

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.2340E 02	0.3310E 02	0.5400E 03	0.1476E 00	0.6465E 05	0.5000E 01	0.7180E 00	0.1586E 02	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.1870E-01	0.7365E 01	0.2123E 01	0.9872E 00	0.3425E 01	0.1043E 06

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.209	0.50	0.6137	0.0117352	0.0042000	0.1351E 05	0.2180E 05	0.8665	0.1000E 01	0.484730E-02	0.515427E-02	-0.595567E 01
0.258	0.50	0.5596	0.0107014	0.0038300	0.1668E 05	0.2691E 05	0.8665	0.1000E 01	0.442028E-02	0.463907E-02	-0.471609E 01
0.306	0.50	0.5187	0.0099190	0.0035500	0.1978E 05	0.3192E 05	0.8665	0.1000E 01	0.409713E-02	0.425971E-02	-0.381659E 01
0.416	0.50	0.3770	0.0072088	0.0025800	0.2689E 05	0.4339E 05	0.8665	0.1000E 01	0.297763E-02	0.365337E-02	-0.184963E 02
0.502	0.50	0.3434	0.0065661	0.0023500	0.3245E 05	0.5236E 05	0.8665	0.1000E 01	0.271219E-02	0.332574E-02	-0.184487E 02
0.559	0.50	0.3580	0.0068455	0.0024500	0.3614E 05	0.5830E 05	0.8665	0.1000E 01	0.282760E-02	0.315163E-02	-0.102814E 02
0.641	0.50	0.3288	0.0062867	0.0022500	0.4144E 05	0.6686E 05	0.8665	0.1000E 01	0.259677E-02	0.294315E-02	-0.117688E 02

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Table 3. Continued

LAMINAR BOUNDARY LAYER DATA FROM PRINCETON N-3 AND N-5 TUNNELS

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.2440E 02	0.3000E 02	0.5400E 03	0.1499E 00	0.8706E 05	0.5000E 01	0.7180E 00	0.1618E 02	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	RDUE/RDUINF	REELS
0.2020E-01	0.7898E 01	0.2209E 01	0.9858E 00	0.3524E 01	0.1389E 06

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTRDE	EDGE PARA	T.E.P.	P.E.
0.258	0.50	0.5640	0.0092810	0.0032300	0.2246E 05	0.3583E 05	0.8685	0.1000E 01	0.371925E-02	0.402016E-02	-0.748507E 01
0.306	0.50	0.4854	0.0079880	0.0027800	0.2664E 05	0.4250E 05	0.8685	0.1000E 01	0.320109E-02	0.369141E-02	-0.132829E 02
0.364	0.50	0.4121	0.0067812	0.0023600	0.3169E 05	0.5055E 05	0.8685	0.1000E 01	0.271747E-02	0.338456E-02	-0.197099E 02
0.450	0.50	0.3492	0.0057468	0.0020000	0.3918E 05	0.6250E 05	0.8685	0.1000E 01	0.230294E-02	0.304402E-02	-0.243453E 02
0.562	0.50	0.3544	0.0058330	0.0020300	0.4893E 05	0.7805E 05	0.8685	0.1000E 01	0.233749E-02	0.272386E-02	-0.141849E 02
0.648	0.50	0.3283	0.0054020	0.0018800	0.5642E 05	0.9000E 05	0.8685	0.1000E 01	0.216476E-02	0.253668E-02	-0.146616E 02
0.749	0.50	0.3405	0.0056031	0.0019500	0.6521E 05	0.1040E 06	0.8685	0.1000E 01	0.224537E-02	0.235946E-02	-0.483543E 01

LAMINAR BOUNDARY LAYER DATA FROM PRINCETON N-3 AND N-5 TUNNELS

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1860E 02	0.4360E 02	0.5400E 03	0.1764E 00	0.3448E 06	0.5000E 01	0.7180E 00	0.1394E 02	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	RDUE/ROUINF	REELS
0.2160E 00	0.5112E 01	0.1756E 01	0.9931E 00	0.2891E 01	0.5674E 06

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTRDE	EDGE PARA	T.E.P.	P.E.
0.213	0.50	1.5269	0.0045153	0.0019300	0.7344E 05	0.1209E 06	0.8819	0.1000E 01	0.218851E-02	0.218894E-02	-0.198693E-01
0.270	0.50	1.3687	0.0040474	0.0017300	0.9310E 05	0.1532E 06	0.8819	0.1000E 01	0.196172E-02	0.194421E-02	0.900781E 00
0.332	0.50	1.1709	0.0034625	0.0014800	0.1145E 06	0.1884E 06	0.8819	0.1000E 01	0.167823E-02	0.175330E-02	-0.428118E 01
0.441	0.50	0.9494	0.0028075	0.0012000	0.1521E 06	0.2502E 06	0.8819	0.1000E 01	0.136073E-02	0.152127E-02	-0.105528E 02
0.529	0.50	0.8228	0.0024331	0.0010400	0.1824E 06	0.3002E 06	0.8819	0.1000E 01	0.117930E-02	0.138898E-02	-0.150961E 02
0.758	0.50	0.7120	0.0021056	0.0009000	0.2614E 06	0.4301E 06	0.8819	0.1000E 01	0.102055E-02	0.116035E-02	-0.120484E 02

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Table 3. Continued

LAMINAR BOUNDARY LAYER DATA FROM PRINCETON N-3 AND N-5 TUNNELS

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.2460E 02	0.2950E 02	0.5400E 03	0.1500E 00	0.2931E 05	0.1500E 02	0.2500E 00	0.7318E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.2020E-01	0.6066E 02	0.1061E 02	0.9690E 00	0.5540E 01	0.1577E 05

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.311	0.50	2.5652	0.0415519	0.0092000	0.9115E 04	0.4905E 04	0.8668	0.1000E 01	0.106139E-01	0.108663E-01	-0.232267E 01
0.355	0.50	2.4816	0.0401970	0.0089000	0.1041E 05	0.5599E 04	0.8668	0.1000E 01	0.102678E-01	0.101706E-01	0.955477E 00
0.419	0.50	2.2306	0.0361321	0.0080000	0.1228E 05	0.6608E 04	0.8668	0.1000E 01	0.922948E-02	0.936170E-02	-0.141237E 01
0.469	0.50	2.2306	0.0361321	0.0080000	0.1375E 05	0.7396E 04	0.8668	0.1000E 01	0.922948E-02	0.884861E-02	0.430425E 01
0.545	0.50	1.9797	0.0320672	0.0071000	0.1597E 05	0.8595E 04	0.8668	0.1000E 01	0.819116E-02	0.820848E-02	-0.211033E 00
0.698	0.50	1.6451	0.0266474	0.0059000	0.2046E 05	0.1101E 05	0.8668	0.1000E 01	0.680674E-02	0.725327E-02	-0.615623E 01
0.748	0.50	1.5754	0.0255183	0.0056500	0.2192E 05	0.1180E 05	0.8668	0.1000E 01	0.651832E-02	0.700665E-02	-0.696957E 01
0.818	0.50	1.4778	0.0239375	0.0053000	0.2398E 05	0.1290E 05	0.8668	0.1000E 01	0.611452E-02	0.670015E-02	-0.874050E 01

LAMINAR BOUNDARY LAYER DATA FROM PRINCETON N-3 AND N-5 TUNNELS

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.2470E 02	0.2920E 02	0.5400E 03	0.1503E 00	0.2907E 05	0.1500E 02	0.2500E 00	0.7324E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.2020E-01	0.6115E 02	0.1069E 02	0.9695E 00	0.5546E 01	0.1554E 05

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.308	0.50	2.6974	0.0434056	0.0096000	0.8954E 04	0.4787E 04	0.8668	0.1000E 01	0.110752E-01	0.109995E-01	0.687481E 00
0.360	0.50	2.5008	0.0402406	0.0089000	0.1047E 05	0.5595E 04	0.8668	0.1000E 01	0.102676E-01	0.101741E-01	0.918420E 00
0.425	0.50	2.3322	0.0375278	0.0083000	0.1235E 05	0.6605E 04	0.8668	0.1000E 01	0.957539E-02	0.936386E-02	0.225904E 01
0.476	0.50	2.2760	0.0366235	0.0081000	0.1384E 05	0.7397E 04	0.8668	0.1000E 01	0.934466E-02	0.884802E-02	0.561306E 01
0.541	0.50	2.0793	0.0334585	0.0074000	0.1573E 05	0.8408E 04	0.8668	0.1000E 01	0.853710E-02	0.829948E-02	0.286300E 01
0.650	0.50	1.7421	0.0280328	0.0062000	0.1890E 05	0.1010E 05	0.8668	0.1000E 01	0.715270E-02	0.757169E-02	-0.553360E 01
0.710	0.50	1.5988	0.0257269	0.0056900	0.2064E 05	0.1103E 05	0.8668	0.1000E 01	0.656433E-02	0.724469E-02	-0.939121E 01

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Table 3. Continued

LAMINAR BOUNDARY LAYER DATA FROM PRINCETON N-3 AND N-5 TUNNELS

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1890E 02	0.4220E 02	0.5400E 03	0.1766E 00	0.1236E 06	0.1500E 02	0.2500E 00	0.6846E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.2160E 00	0.3628E 02	0.6812E 01	0.9454E 00	0.5035E 01	0.9334E 05

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.327	0.50	5.4015	0.0154853	0.0038000	0.4042E 05	0.3052E 05	0.8829	0.1000E 01	0.430400E-02	0.435595E-02	-0.119269E 01
0.355	0.50	4.8756	0.0139775	0.0034300	0.4388E 05	0.3313E 05	0.8829	0.1000E 01	0.388493E-02	0.418064E-02	-0.707334E 01
0.407	0.50	4.6197	0.0132440	0.0032500	0.5031E 05	0.3799E 05	0.8829	0.1000E 01	0.368105E-02	0.390445E-02	-0.572155E 01
0.482	0.50	4.0938	0.0117362	0.0028800	0.5958E 05	0.4499E 05	0.8829	0.1000E 01	0.326198E-02	0.358784E-02	-0.908246E 01
0.621	0.50	3.6674	0.0105137	0.0025800	0.7676E 05	0.5796E 05	0.8829	0.1000E 01	0.292219E-02	0.316090E-02	-0.755204E 01
0.739	0.50	3.3262	0.0095357	0.0023400	0.9134E 05	0.6898E 05	0.8829	0.1000E 01	0.265036E-02	0.289757E-02	-0.853183E 01
0.868	0.50	2.9851	0.0085576	0.0021000	0.1073E 06	0.8102E 05	0.8829	0.1000E 01	0.237853E-02	0.267360E-02	-0.110367E 02

LAMINAR BOUNDARY LAYER DATA FROM PRINCETON N-3 AND N-5 TUNNELS

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1810E 02	0.5410E 02	0.5400E 03	0.1500E 00	0.5760E 05	0.1500E 02	0.2500E 00	0.6779E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.1440E 00	0.3337E 02	0.6349E 01	0.9437E 00	0.4960E 01	0.4691E 05

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.328	0.50	5.2682	0.0220402	0.0054500	0.1889E 05	0.1539E 05	0.8747	0.1000E 01	0.623048E-02	0.613511E-02	0.155439E 01
0.422	0.50	4.4949	0.0188049	0.0046500	0.2431E 05	0.1980E 05	0.8747	0.1000E 01	0.531591E-02	0.540883E-02	-0.171800E 01
0.496	0.50	4.0599	0.0169851	0.0042000	0.2857E 05	0.2327E 05	0.8747	0.1000E 01	0.480146E-02	0.498906E-02	-0.376019E 01
0.582	0.50	3.7216	0.0155697	0.0038500	0.3352E 05	0.2730E 05	0.8747	0.1000E 01	0.440134E-02	0.460573E-02	-0.443761E 01
0.693	0.50	3.3832	0.0141542	0.0035000	0.3992E 05	0.3251E 05	0.8747	0.1000E 01	0.400122E-02	0.422078E-02	-0.520190E 01
0.863	0.50	3.2769	0.0137094	0.0033900	0.4971E 05	0.4048E 05	0.8747	0.1000E 01	0.387547E-02	0.378228E-02	0.246381E 01
0.938	0.50	2.9966	0.0125366	0.0031000	0.5403E 05	0.4400E 05	0.8747	0.1000E 01	0.354394E-02	0.362793E-02	-0.231493E 01

Table 3. Continued

LAMINAR BOUNDARY LAYER DATA FROM PRINCETON N-3 AND N-5 TUNNELS

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.2390E 02	0.3120E 02	0.5400E 03	0.1502E 00	0.1099E 05	0.2000E 02	0.1290E 00	0.5437E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.1870E-01	0.9913E 02	0.1690E 02	0.9351E 00	0.5486E 01	0.4020E 04

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.099	0.50	7.5476	0.1399951	0.0313000	0.1094E 04	0.4000E 03	0.8971	0.1000E 01	0.348904E-01	0.380504E-01	-0.830495E 01
0.167	0.50	5.7391	0.1064499	0.0238000	0.1835E 04	0.6713E 03	0.8971	0.1000E 01	0.265300E-01	0.293706E-01	-0.967134E 01
0.211	0.50	4.4128	0.0818502	0.0183000	0.2319E 04	0.8482E 03	0.8971	0.1000E 01	0.203992E-01	0.261294E-01	-0.219303E 02
0.405	0.50	3.7135	0.0688794	0.0154000	0.4451E 04	0.1628E 04	0.8971	0.1000E 01	0.171665E-01	0.188601E-01	-0.897965E 01
0.505	0.50	2.9660	0.0550141	0.0123000	0.5550E 04	0.2030E 04	0.8971	0.1000E 01	0.137109E-01	0.168898E-01	-0.188215E 02
0.908	0.50	2.0497	0.0380178	0.0085000	0.9979E 04	0.3650E 04	0.8971	0.1000E 01	0.947502E-02	0.125959E-01	-0.247767E 02

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LAMINAR BOUNDARY LAYER DATA FROM PRINCETON N-3 AND N-5 TUNNELS

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.2490E 02	0.2880E 02	0.5400E 03	0.1500E 00	0.1468E 05	0.2000E 02	0.1290E 00	0.5380E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.2020E-01	0.1075E 03	0.1817E 02	0.9211E 00	0.5449E 01	0.4950E 04

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.099	0.50	7.9517	0.1257279	0.0283000	0.1453E 04	0.4901E 03	0.8989	0.1000E 01	0.314825E-01	0.343751E-01	-0.841483E 01
0.164	0.50	5.7882	0.0915192	0.0206000	0.2407E 04	0.8119E 03	0.8989	0.1000E 01	0.229166E-01	0.267079E-01	-0.141954E 02
0.228	0.50	4.6081	0.0728599	0.0164000	0.3347E 04	0.1129E 04	0.8989	0.1000E 01	0.182443E-01	0.226514E-01	-0.194561E 02
0.394	0.50	3.8775	0.0613090	0.0138000	0.5784E 04	0.1950E 04	0.8989	0.1000E 01	0.153519E-01	0.172311E-01	-0.109060E 02
0.495	0.50	3.1470	0.0497580	0.0112000	0.7266E 04	0.2450E 04	0.8989	0.1000E 01	0.124595E-01	0.153730E-01	-0.189521E 02
0.758	0.50	2.6693	0.0422055	0.0095000	0.1113E 05	0.3752E 04	0.8989	0.1000E 01	0.105683E-01	0.124230E-01	-0.149294E 02
0.829	0.50	2.3883	0.0377628	0.0085000	0.1217E 05	0.4104E 04	0.8989	0.1000E 01	0.945588E-02	0.118791E-01	-0.203992E 02

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Table 3. Continued

LAMINAR BOUNDARY LAYER DATA FROM PRINCETON N-3 AND N-5 TUNNELS

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(OEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1850E 02	0.4410E 02	0.5400E 03	0.1763E 00	0.6092E 05	0.2000E 02	0.1290E 00	0.5311E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.2160E 00	0.5981E 02	0.1048E 02	0.9295E 00	0.5303E 01	0.3375E 05

EXPERIMENTAL OATA

X/L	N	QODT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTRDE	EOGE PARA	T.E.P.	P.E.
0.096	0.50	15.5177	0.0463555	0.0108000	0.5848E 04	0.3240E 04	0.9030	0.1000E 01	0.119596E-01	0.133685E-01	-0.105385E 02
0.157	0.50	12.5004	0.0373420	0.0087000	0.9564E 04	0.5300E 04	0.9030	0.1000E 01	0.963414E-02	0.104536E-01	-0.783928E 01
0.379	0.50	8.1899	0.0244654	0.0057000	0.2309E 05	0.1279E 05	0.9030	0.1000E 01	0.631202E-02	0.672817E-02	-0.618522E 01
0.470	0.50	6.5376	0.0195294	0.0045500	0.2863E 05	0.1586E 05	0.9030	0.1000E 01	0.503854E-02	0.604182E-02	-0.166055E 02
0.592	0.50	6.1784	0.0184564	0.0043000	0.3606E 05	0.1998E 05	0.9030	0.1000E 01	0.476170E-02	0.538339E-02	-0.115483E 02

LAMINAR BOUNDARY LAYER DATA FROM PRINCETON N-3 AND N-5 TUNNELS

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1770E 02	0.5660E 02	0.5400E 03	0.1499E 00	0.2666E 05	0.2000E 02	0.1290E 00	0.5247E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.1440E 00	0.5484E 02	0.9695E 01	0.9230E 00	0.5221E 01	0.1633E 05

EXPERIMENTAL DATA

X/L	N	QDDT	STINF	STEAW	REINFL	REEL	CSTAREN	RDSTROE	EDGE PARA	T.E.P.	P.E.
0.165	0.50	11.9821	0.0523607	0.0123000	0.4399E 04	0.2694E 04	0.9022	0.1000E 01	0.136331E-01	0.146628E-01	-0.702229E 01
0.398	0.50	8.1829	0.0357585	0.0084000	0.1061E 05	0.6497E 04	0.9022	0.1000E 01	0.931041E-02	0.944097E-02	-0.138287E 01
0.490	0.50	6.5268	0.0285216	0.0067000	0.1306E 05	0.7999E 04	0.9022	0.1000E 01	0.742616E-02	0.850863E-02	-0.127220E 02
0.563	0.50	6.8191	0.0297987	0.0070000	0.1501E 05	0.9191E 04	0.9022	0.1000E 01	0.775868E-02	0.793786E-02	-0.225732E 01
0.631	0.50	5.9423	0.0259675	0.0061000	0.1682E 05	0.1030E 05	0.9022	0.1000E 01	0.676113E-02	0.749796E-02	-0.982696E 01
0.796	0.50	5.1630	0.0225619	0.0053000	0.2122E 05	0.1299E 05	0.9022	0.1000E 01	0.587443E-02	0.667576E-02	-0.120037E 02

Table 3. Continued

LAMINAR 5.0 OEG. CONE OATA FROM NOL HYPERSONIC TUNNEL

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.7900E 01	0.1090E 03	0.5160E 03	0.3511E 00	0.1835E 08	0.5000E 01	0.2008E 01	0.7182E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.3498E 02	0.1878E 01	0.1200E 01	0.9959E 00	0.1558E 01	0.2383E 08

EXPERIMENTAL OATA

N	QOOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EOGE PARA	T.E.P.	P.E.
0.50	3.2213	0.0005788	0.0004900	0.1468E 07	0.1906E 07	0.9330	0.1000E 01	0.525189E-03	0.551213E-03	-0.472134E 01
0.50	2.6296	0.0004725	0.0004000	0.2074E 07	0.2692E 07	0.9330	0.1000E 01	0.428725E-03	0.463794E-03	-0.756132E 01
0.50	2.4981	0.0004488	0.0003800	0.2771E 07	0.3598E 07	0.9330	0.1000E 01	0.407289E-03	0.401214E-03	0.151422E 01

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LAMINAR 5.0 OEG. CONE OATA FROM NOL HYPERSONIC TUNNEL

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.7900E 01	0.1070E 03	0.4900E 03	0.3397E 00	0.1249E 08	0.5000E 01	0.2008E 01	0.7182E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.2352E 02	0.1878E 01	0.1200E 01	0.9959E 00	0.1558E 01	0.1621E 08

EXPERIMENTAL DATA

N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.50	3.0923	0.0008195	0.0006900	0.9242E 06	0.1200E 07	0.9367	0.1000E 01	0.736607E-03	0.694766E-03	0.602239E 01
0.50	2.1960	0.0005820	0.0004900	0.1461E 07	0.1897E 07	0.9367	0.1000E 01	0.523098E-03	0.552537E-03	-0.532803E 01
0.50	1.8823	0.0004988	0.0004200	0.1923E 07	0.2497E 07	0.9367	0.1000E 01	0.448369E-03	0.481608E-03	-0.690165E 01
0.50	1.7926	0.0004751	0.0004000	0.2385E 07	0.3097E 07	0.9367	0.1000E 01	0.427018E-03	0.432451E-03	-0.125630E 01

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Table 3. Continued

LAMINAR 5.0 DEG. CONE DATA FROM NOL HYPERSONIC TUNNEL

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.7900E 01	0.1066E 03	0.4630E 03	0.3222E 00	0.1867E 08	0.5000E 01	0.2008E 01	0.7182E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.3501E 02	0.1878E 01	0.1200E 01	0.9959E 00	0.1558E 01	0.2424E 08

EXPERIMENTAL DATA

N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.50	3.3761	0.0005867	0.0004900	0.1382E 07	0.1794E 07	0.9397	0.1000E 01	0.521463E-03	0.568177E-03	-0.822168E 01
0.50	2.8938	0.0005029	0.0004200	0.2166E 07	0.2812E 07	0.9397	0.1000E 01	0.446969E-03	0.453806E-03	-0.150661E 01
0.50	2.5493	0.0004430	0.0003700	0.2857E 07	0.3709E 07	0.9397	0.1000E 01	0.393758E-03	0.395142E-03	-0.350358E 00

LAMINAR 5.0 DEG. CONE DATA FROM NOL HYPERSONIC TUNNEL

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.7900E 01	0.1084E 03	0.3540E 03	0.2422E 00	0.1851E 08	0.5000E 01	0.2008E 01	0.7182E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.3505E 02	0.1878E 01	0.1200E 01	0.9959E 00	0.1558E 01	0.2403E 08

EXPERIMENTAL DATA

N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.50	3.3699	0.0005188	0.0004200	0.2074E 07	0.2692E 07	0.9497	0.1000E 01	0.442253E-03	0.463830E-03	-0.465194E 01
0.50	3.0489	0.0004694	0.0003800	0.2851E 07	0.3701E 07	0.9497	0.1000E 01	0.400133E-03	0.395555E-03	0.115740E 01

Table 3. Continued

LAMINAR 5.0 OEG. CONE OATA FROM NOL HYPERSONIC TUNNEL

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.7900E 01	0.1068E 03	0.2840E 03	0.1972E 00	0.1867E 08	0.5000E 01	0.2008E 01	0.7182E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.3501E 02	0.1878E 01	0.1200E 01	0.9959E 00	0.1558E 01	0.2424E 08

EXPERIMENTAL DATA

N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.50	4.7028	0.0006894	0.0005500	0.1382E 07	0.1794E 07	0.9578	0.1000E 01	0.574209E-03	0.568177E-03	0.106159E 01
0.50	3.5057	0.0005139	0.0004100	0.2148E 07	0.2788E 07	0.9578	0.1000E 01	0.428046E-03	0.455775E-03	-0.608386E 01
0.50	3.0782	0.0004512	0.0003600	0.2838E 07	0.3685E 07	0.9578	0.1000E 01	0.375846E-03	0.396440E-03	-0.519476E 01

LAMINAR 5.0 DEG. CONE DATA FROM NOL HYPERSONIC TUNNEL

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.7900E 01	0.1084E 03	0.1580E 03	0.1081E 00	0.1845E 08	0.5000E 01	0.2008E 01	0.7182E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.3501E 02	0.1878E 01	0.1200E 01	0.9959E 00	0.1558E 01	0.2396E 08

EXPERIMENTAL DATA

N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.50	3.5292	0.0004622	0.0003600	0.2085E 07	0.2707E 07	0.9698	0.1000E 01	0.371205E-03	0.462523E-03	-0.197435E 02
0.50	3.1371	0.0004108	0.0003200	0.2768E 07	0.3593E 07	0.9698	0.1000E 01	0.329960E-03	0.401446E-03	-0.178072E 02

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Table 3. Continued

LAMINAR 10.0 DEG. CONE DATA FROM NASA LANGLEY 11 INCH HYPERSONIC TUNNEL

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.6820E 01	0.1024E 03	0.5490E 03	0.5204E 00	0.1908E 07	0.1000E 02	0.1015E 01	0.5586E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.7632E 01	0.3273E 01	0.1449E 01	0.9860E 00	0.2227E 01	0.2932E 07

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.257	0.50	0.8379	0.0014600	0.0009745	0.4904E 06	0.7536E 06	0.9436	0.1000E 01	0.103277E-02	0.876623E-03	0.178127E 02
0.339	0.50	0.7289	0.0012700	0.0008477	0.6468E 06	0.9941E 06	0.9436	0.1000E 01	0.898371E-03	0.763272E-03	0.177000E 02
0.421	0.50	0.6256	0.0010900	0.0007276	0.8033E 06	0.1235E 07	0.9436	0.1000E 01	0.771043E-03	0.684917E-03	0.125746E 02
0.503	0.50	0.5280	0.0009200	0.0006141	0.9597E 06	0.1475E 07	0.9436	0.1000E 01	0.650788E-03	0.626607E-03	0.385909E 01
0.585	0.50	0.4936	0.0008600	0.0005740	0.1116E 07	0.1715E 07	0.9436	0.1000E 01	0.608346E-03	0.581034E-03	0.470062E 01
0.671	0.50	0.4591	0.0008000	0.0005340	0.1280E 07	0.1968E 07	0.9436	0.1000E 01	0.565903E-03	0.542523E-03	0.430957E 01
0.749	0.50	0.4247	0.0007400	0.0004939	0.1429E 07	0.2196E 07	0.9436	0.1000E 01	0.523460E-03	0.513497E-03	0.194019E 01
0.913	0.50	0.3903	0.0006800	0.0004539	0.1742E 07	0.2677E 07	0.9436	0.1000E 01	0.481017E-03	0.465097E-03	0.342295E 01
0.954	0.50	0.3788	0.0006600	0.0004405	0.1820E 07	0.2797E 07	0.9436	0.1000E 01	0.466870E-03	0.454993E-03	0.261030E 01

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LAMINAR 10.0 DEG. CONE DATA FROM NASA LANGLEY 11 INCH HYPERSONIC TUNNEL

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.6840E 01	0.1014E 03	0.5460E 03	0.5199E 00	0.2954E 07	0.1000E 02	0.1015E 01	0.5599E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.1161E 02	0.3286E 01	0.1451E 01	0.9861E 00	0.2233E 01	0.4544E 07

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.257	0.50	1.0435	0.0011900	0.0007920	0.7592E 06	0.1168E 07	0.9442	0.1000E 01	0.838858E-03	0.704201E-03	0.191220E 02
0.339	0.50	0.9295	0.0010600	0.0007055	0.1001E 07	0.1540E 07	0.9442	0.1000E 01	0.747219E-03	0.613145E-03	0.218666E 02
0.421	0.50	0.7804	0.0008900	0.0005924	0.1244E 07	0.1913E 07	0.9442	0.1000E 01	0.627382E-03	0.550202E-03	0.140275E 02
0.503	0.50	0.6401	0.0007300	0.0004859	0.1486E 07	0.2286E 07	0.9442	0.1000E 01	0.514594E-03	0.503361E-03	0.223168E 01
0.585	0.50	0.5875	0.0006700	0.0004459	0.1728E 07	0.2658E 07	0.9442	0.1000E 01	0.472299E-03	0.466751E-03	0.118857E 01
0.671	0.50	0.5524	0.0006300	0.0004193	0.1982E 07	0.3049E 07	0.9442	0.1000E 01	0.444102E-03	0.435815E-03	0.190147E 01
0.749	0.50	0.5349	0.0006100	0.0004060	0.2213E 07	0.3403E 07	0.9442	0.1000E 01	0.430003E-03	0.412498E-03	0.424363E 01

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Table 3. Continued

LAMINAR 10.0 DEG. CONE DATA FROM NASA LANGLEY 11 INCH HYPERSONIC TUNNEL

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.6860E 01	0.1028E 03	0.5560E 03	0.5195E 00	0.4771E 07	0.1000E 02	0.1015E 01	0.5612E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.1900E 02	0.3298E 01	0.1453E 01	0.9862E 00	0.2238E 01	0.7346E 07

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.257	0.50	1.3123	0.0009000	0.0005973	0.1226E 07	0.1888E 07	0.9423	0.1000E 01	0.633944E-03	0.553858E-03	0.144595E 02
0.339	0.50	1.1373	0.0007800	0.0005177	0.1617E 07	0.2490E 07	0.9423	0.1000E 01	0.549418E-03	0.482243E-03	0.139297E 02
0.421	0.50	1.0061	0.0006900	0.0004580	0.2009E 07	0.3093E 07	0.9423	0.1000E 01	0.486023E-03	0.432737E-03	0.123138E 02
0.503	0.50	0.8457	0.0005800	0.0003849	0.2400E 07	0.3695E 07	0.9423	0.1000E 01	0.408541E-03	0.395896E-03	0.319409E 01
0.585	0.50	0.8019	0.0005500	0.0003650	0.2791E 07	0.4297E 07	0.9423	0.1000E 01	0.387410E-03	0.367102E-03	0.553189E 01

LAMINAR 10.0 DEG. CONE DATA FROM NASA LANGLEY 11 INCH HYPERSONIC TUNNEL

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.6860E 01	0.1002E 03	0.5530E 03	0.5301E 00	0.6303E 07	0.1000E 02	0.1015E 01	0.5612E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.2412E 02	0.3298E 01	0.1453E 01	0.9862E 00	0.2238E 01	0.9705E 07

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.257	0.50	1.4833	0.0008300	0.0005570	0.1620E 07	0.2494E 07	0.9438	0.1000E 01	0.590121E-03	0.481870E-03	0.224646E 02
0.339	0.50	1.3225	0.0007400	0.0004966	0.2137E 07	0.3290E 07	0.9438	0.1000E 01	0.526132E-03	0.419562E-03	0.254001E 02
0.421	0.50	1.1259	0.0006300	0.0004228	0.2654E 07	0.4086E 07	0.9438	0.1000E 01	0.447923E-03	0.376492E-03	0.189728E 02
0.503	0.50	0.9472	0.0005300	0.0003557	0.3170E 07	0.4881E 07	0.9438	0.1000E 01	0.376824E-03	0.344439E-03	0.940221E 01

Table 3. Continued

LAMINAR 10.0 DEG. CONE DATA FROM NASA LANGLEY 11 INCH HYPERSONIC TUNNEL

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.6840E 01	0.1139E 03	0.5550E 03	0.4705E 00	0.2570E 07	0.1000E 02	0.1015E 01	0.5599E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.1214E 02	0.3286E 01	0.1451E 01	0.9861E 00	0.2233E 01	0.3953E 07

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.257	0.50	1.5112	0.0014100	0.0008977	0.6605E 06	0.1016E 07	0.9372	0.1000E 01	0.957893E-03	0.754980E-03	0.268766E 02
0.339	0.50	1.2862	0.0012000	0.0007640	0.8712E 06	0.1340E 07	0.9372	0.1000E 01	0.815228E-03	0.657358E-03	0.240158E 02
0.421	0.50	1.1040	0.0010300	0.0006558	0.1082E 07	0.1664E 07	0.9372	0.1000E 01	0.699738E-03	0.589876E-03	0.186245E 02
0.503	0.50	0.9325	0.0008700	0.0005539	0.1293E 07	0.1989E 07	0.9372	0.1000E 01	0.591041E-03	0.539657E-03	0.952148E 01
0.585	0.50	0.8682	0.0008100	0.0005157	0.1503E 07	0.2313E 07	0.9372	0.1000E 01	0.550279E-03	0.500408E-03	0.996620E 01
0.671	0.50	0.8360	0.0007800	0.0004966	0.1724E 07	0.2653E 07	0.9372	0.1000E 01	0.529899E-03	0.467241E-03	0.134101E 02
0.749	0.50	0.7395	0.0006900	0.0004393	0.1925E 07	0.2961E 07	0.9372	0.1000E 01	0.468757E-03	0.442243E-03	0.599525E 01

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LAMINAR 10.0 DEG. CONE DATA FROM NASA LANGLEY 11 INCH HYPERSONIC TUNNEL

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.6860E 01	0.1152E 03	0.5520E 03	0.4602E 00	0.3610E 07	0.1000E 02	0.1015E 01	0.5612E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.1731E 02	0.3298E 01	0.1453E 01	0.9862E 00	0.2238E 01	0.5558E 07

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.257	0.50	1.9113	0.0012100	0.0007625	0.9278E 06	0.1428E 07	0.9366	0.1000E 01	0.814064E-03	0.636722E-03	0.278523E 02
0.339	0.50	1.7060	0.0010800	0.0006806	0.1224E 07	0.1884E 07	0.9366	0.1000E 01	0.726602E-03	0.554392E-03	0.310629E 02
0.421	0.50	1.4059	0.0008900	0.0005608	0.1520E 07	0.2340E 07	0.9366	0.1000E 01	0.598774E-03	0.497480E-03	0.203614E 02
0.503	0.50	1.1689	0.0007400	0.0004663	0.1816E 07	0.2796E 07	0.9366	0.1000E 01	0.497857E-03	0.455127E-03	0.938854E 01
0.585	0.50	1.1057	0.0007000	0.0004411	0.2112E 07	0.3252E 07	0.9366	0.1000E 01	0.470946E-03	0.422025E-03	0.115918E 02

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Table 3. Continued

LAMINAR 10.0 OEG. CONE OATA FROM NASA LANGLEY 11 INCH HYPERSONIC TUNNEL

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.6830E 01	0.1201E 03	0.5630E 03	0.4538E 00	0.4679E 07	0.1000E 02	0.1015E 01	0.5592E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.2391E 02	0.3280E 01	0.1450E 01	0.9861E 00	0.2230E 01	0.7194E 07

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.257	0.50	2.3380	0.0010500	0.0006608	0.1203E 07	0.1849E 07	0.9336	0.1000E 01	0.707853E-03	0.559661E-03	0.264790E 02
0.339	0.50	2.1153	0.0009500	0.0005979	0.1586E 07	0.2439E 07	0.9336	0.1000E 01	0.640438E-03	0.487295E-03	0.314273E 02
0.421	0.50	1.7813	0.0008000	0.0005035	0.1970E 07	0.3029E 07	0.9336	0.1000E 01	0.539316E-03	0.437271E-03	0.233370E 02
0.503	0.50	1.5364	0.0006900	0.0004343	0.2354E 07	0.3619E 07	0.9336	0.1000E 01	0.465160E-03	0.400044E-03	0.162774E 02

LAMINAR SHARP CONE DATA FROM VKF 50 IN. HYPERSONIC TUNNEL B

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(OEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.8000E 01	0.9803E 02	0.4868E 03	0.3598E 00	0.1740E 08	0.4000E 01	0.4783E 01	0.7435E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.1245E 02	0.1616E 01	0.1149E 01	0.9962E 00	0.1401E 01	0.2122E 08

EXPERIMENTAL OATA

X/L	N	QOOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.164	0.50	0.8979	0.0004674	0.0004420	0.2853E 07	0.3480E 07	0.9416	0.1000E 01	0.469424E-03	0.407950E-03	0.150688E 02
0.177	0.50	0.7473	0.0003890	0.0003679	0.3080E 07	0.3756E 07	0.9416	0.1000E 01	0.390684E-03	0.392683E-03	-0.509083E 00
0.190	0.50	0.8899	0.0004632	0.0004380	0.3306E 07	0.4031E 07	0.9416	0.1000E 01	0.465205E-03	0.379011E-03	0.227418E 02
0.203	0.50	0.8414	0.0004380	0.0004142	0.3532E 07	0.4307E 07	0.9416	0.1000E 01	0.439896E-03	0.366675E-03	0.199690E 02
0.216	0.50	0.7838	0.0004080	0.0003858	0.3758E 07	0.4583E 07	0.9416	0.1000E 01	0.409767E-03	0.355469E-03	0.152748E 02
0.230	0.50	0.7832	0.0004077	0.0003855	0.4002E 07	0.4880E 07	0.9416	0.1000E 01	0.409465E-03	0.344401E-03	0.188644E 02
0.243	0.50	0.7636	0.0003975	0.0003759	0.4228E 07	0.5156E 07	0.9416	0.1000E 01	0.399221E-03	0.335140E-03	0.191207E 02
0.299	0.50	0.6862	0.0003572	0.0003378	0.5202E 07	0.6344E 07	0.9416	0.1000E 01	0.358747E-03	0.302130E-03	0.187392E 02
0.334	0.50	0.6380	0.0003321	0.0003141	0.5811E 07	0.7087E 07	0.9416	0.1000E 01	0.333538E-03	0.285862E-03	0.166781E 02
0.369	0.50	0.6169	0.0003211	0.0003037	0.6420E 07	0.7830E 07	0.9416	0.1000E 01	0.322490E-03	0.271967E-03	0.185771E 02
0.404	0.50	0.6441	0.0003353	0.0003171	0.7029E 07	0.8572E 07	0.9416	0.1000E 01	0.336752E-03	0.259919E-03	0.295602E 02
0.439	0.50	0.5723	0.0002979	0.0002817	0.7638E 07	0.9315E 07	0.9416	0.1000E 01	0.299190E-03	0.249343E-03	0.199913E 02

Table 3. Continued

LAMINAR SHARP CONE DATA FROM VKF 50 IN. HYPERSONIC TUNNEL B

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.8000E 01	0.9803E 02	0.4898E 03	0.3621E 00	0.1740E 08	0.4000E 01	0.4783E 01	0.7435E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.1245E 02	0.1616E 01	0.1149E 01	0.9962E 00	0.1401E 01	0.2122E 08

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.164	0.50	0.7327	0.0003827	0.0003623	0.2853E 07	0.3480E 07	0.9413	0.1000E 01	0.384915E-03	0.407950E-03	-0.564654E 01
0.190	0.50	0.6794	0.0003549	0.0003360	0.3306E 07	0.4031E 07	0.9413	0.1000E 01	0.356955E-03	0.379011E-03	-0.581955E 01
0.216	0.50	0.6136	0.0003205	0.0003034	0.3758E 07	0.4583E 07	0.9413	0.1000E 01	0.322355E-03	0.355469E-03	-0.931554E 01
0.243	0.50	0.6121	0.0003197	0.0003027	0.4228E 07	0.5156E 07	0.9413	0.1000E 01	0.321551E-03	0.335140E-03	-0.405477E 01
0.299	0.50	0.5694	0.0002974	0.0002816	0.5202E 07	0.6344E 07	0.9413	0.1000E 01	0.299122E-03	0.302130E-03	-0.995655E 00
0.334	0.50	0.5701	0.0002978	0.0002819	0.5811E 07	0.7087E 07	0.9413	0.1000E 01	0.299524E-03	0.285862E-03	0.477941E 01
0.369	0.50	0.5186	0.0002709	0.0002565	0.6420E 07	0.7830E 07	0.9413	0.1000E 01	0.272468E-03	0.271967E-03	0.184318E 00
0.404	0.50	0.5399	0.0002820	0.0002670	0.7029E 07	0.8572E 07	0.9413	0.1000E 01	0.283632E-03	0.259919E-03	0.912335E 01
0.439	0.50	0.5359	0.0002799	0.0002650	0.7638E 07	0.9315E 07	0.9413	0.1000E 01	0.281520E-03	0.249343E-03	0.129049E 02
0.516	0.50	0.5110	0.0002669	0.0002527	0.8978E 07	0.1095E 08	0.9413	0.1000E 01	0.268445E-03	0.229988E-03	0.167214E 02
0.551	0.50	0.5068	0.0002647	0.0002506	0.9587E 07	0.1169E 08	0.9413	0.1000E 01	0.266232E-03	0.222563E-03	0.196208E 02

LAMINAR SHARP CONE DATA FROM VKF 50 IN. HYPERSONIC TUNNEL B

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.7950E 01	0.9200E 02	0.5330E 03	0.4247E 00	0.5030E 07	0.7200E 01	0.3608E 01	0.6817E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.4360E 01	0.2673E 01	0.1345E 01	0.9946E 00	0.1976E 01	0.7387E 07

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.268	0.50	0.3857	0.0006705	0.0004667	0.1348E 07	0.1980E 07	0.9393	0.1000E 01	0.496863E-03	0.540841E-03	-0.813141E 01
0.315	0.50	0.3790	0.0006588	0.0004586	0.1584E 07	0.2327E 07	0.9393	0.1000E 01	0.488193E-03	0.498863E-03	-0.213894E 01
0.408	0.50	0.3567	0.0006201	0.0004316	0.2052E 07	0.3014E 07	0.9393	0.1000E 01	0.459515E-03	0.438335E-03	0.483174E 01
0.454	0.50	0.3702	0.0006434	0.0004479	0.2284E 07	0.3354E 07	0.9393	0.1000E 01	0.476781E-03	0.415536E-03	0.147387E 02
0.501	0.50	0.3558	0.0006184	0.0004305	0.2520E 07	0.3701E 07	0.9393	0.1000E 01	0.458255E-03	0.395565E-03	0.158482E 02

Table 3. Continued

LAMINAR SHARP CONE DATA FROM VKF 50 IN. HYPERSONIC TUNNEL B

MINF	TINF(R)	TW(R)	TW/TO	REINFL5	THETA(DEG)	L5(FT)	ME	ALT(FT)	UINF(FT/5EC)
0.7950E 01	0.9200E 02	0.5300E 03	0.4223E 00	0.5030E 07	0.7200E 01	0.3608E 01	0.6817E 01	0.1000E 01	0.1000E 01

PINF(P5F)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REEL5
0.4360E 01	0.2673E 01	0.1345E 01	0.9946E 00	0.1976E 01	0.7387E 07

EXPERIMENTAL DATA

X/L	N	QDOT	5TINF	STEAW	REINFL	REEL	C5TAREN	RO5TROE	EDGE PARA	T.E.P.	P.E.
0.268	0.50	0.4125	0.0007140	0.0004962	0.1348E 07	0.1980E 07	0.9396	0.1000E 01	0.528107E-03	0.540841E-03	-0.235439E 01
0.315	0.50	0.3767	0.0006520	0.0004531	0.1584E 07	0.2327E 07	0.9396	0.1000E 01	0.482249E-03	0.498863E-03	-0.333035E 01
0.361	0.50	0.3836	0.0006640	0.0004615	0.1816E 07	0.2667E 07	0.9396	0.1000E 01	0.491125E-03	0.465997E-03	0.539231E 01
0.408	0.50	0.3536	0.0006120	0.0004253	0.2052E 07	0.3014E 07	0.9396	0.1000E 01	0.452663E-03	0.438335E-03	0.326866E 01
0.454	0.50	0.3397	0.0005880	0.0004087	0.2284E 07	0.3354E 07	0.9396	0.1000E 01	0.434912E-03	0.415536E-03	0.466288E 01
0.501	0.50	0.3224	0.0005580	0.0003878	0.2520E 07	0.3701E 07	0.9396	0.1000E 01	0.412722E-03	0.395565E-03	0.433747E 01

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LAMINAR SHARP CONE OATA FROM VKF 50 IN. HYPERSONIC TUNNEL C

MINF	TINF(R)	TW(R)	TW/TO	REINFL5	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1000E 02	0.9570E 02	0.5280E 03	0.2627E 00	0.4828E 07	0.7170E 01	0.3603E 01	0.8164E 01	0.1000E 01	0.1000E 01

PINF(P5F)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REEL5
0.3534E 01	0.3521E 01	0.1492E 01	0.9972E 00	0.2354E 01	0.7617E 07

EXPERIMENTAL DATA

X/L	N	QOOT	5TINF	5TEAW	REINFL	REEL	C5TAREN	RO5TROE	EDGE PARA	T.E.P.	P.E.
0.315	0.50	1.0505	0.0008900	0.0004805	0.1521E 07	0.2399E 07	0.9112	0.1000E 01	0.527269E-03	0.491295E-03	0.732227E 01
0.408	0.50	0.9325	0.0007900	0.0004265	0.1970E 07	0.3108E 07	0.9112	0.1000E 01	0.468025E-03	0.431686E-03	0.841805E 01
0.454	0.50	0.9561	0.0008100	0.0004373	0.2192E 07	0.3458E 07	0.9112	0.1000E 01	0.479874E-03	0.409232E-03	0.172620E 02
0.501	0.50	0.9207	0.0007800	0.0004211	0.2419E 07	0.3816E 07	0.9112	0.1000E 01	0.462101E-03	0.389564E-03	0.186200E 02

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Table 3. Continued

LAMINAR SHARP CONE DATA FROM VKF 50 IN. HYPERSONIC TUNNEL C

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1025E 02	0.8630E 02	0.5320E 03	0.2800E 00	0.6279E 07	0.8000E 01	0.2990E 01	0.8050E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.4960E 01	0.4226E 01	0.1610E 01	0.9965E 00	0.2615E 01	0.1020E 08

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.190	0.50	1.8816	0.0011400	0.0005575	0.1193E 07	0.1938E 07	0.9147	0.1000E 01	0.609450E-03	0.546670E-03	0.114841E 02
0.240	0.50	1.6010	0.0009700	0.0004743	0.1507E 07	0.2448E 07	0.9147	0.1000E 01	0.518567E-03	0.486403E-03	0.661251E 01
0.300	0.50	1.4195	0.0008600	0.0004205	0.1884E 07	0.3060E 07	0.9147	0.1000E 01	0.459760E-03	0.435052E-03	0.567926E 01
0.190	0.50	2.2613	0.0013700	0.0006699	0.1193E 07	0.1938E 07	0.9147	0.1000E 01	0.732409E-03	0.546670E-03	0.339765E 02
0.240	0.50	2.0797	0.0012600	0.0006161	0.1507E 07	0.2448E 07	0.9147	0.1000E 01	0.673602E-03	0.486403E-03	0.384864E 02
0.300	0.50	1.7166	0.0010400	0.0005086	0.1884E 07	0.3060E 07	0.9147	0.1000E 01	0.555989E-03	0.435052E-03	0.277982E 02

LAMINAR SHARP CONE DATA FROM VKF 50 IN. HYPERSONIC TUNNEL C

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1022E 02	0.8680E 02	0.5320E 03	0.2800E 00	0.4485E 07	0.8000E 01	0.2990E 01	0.8033E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.3740E 01	0.4208E 01	0.1607E 01	0.9965E 00	0.2609E 01	0.7281E 07

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.190	0.50	1.6461	0.0013300	0.0006519	0.8521E 06	0.1383E 07	0.9147	0.1000E 01	0.712731E-03	0.647005E-03	0.101585E 02
0.240	0.50	1.4728	0.0011900	0.0005833	0.1076E 07	0.1747E 07	0.9147	0.1000E 01	0.637707E-03	0.575677E-03	0.107751E 02
0.300	0.50	1.2748	0.0010300	0.0005049	0.1345E 07	0.2184E 07	0.9147	0.1000E 01	0.551964E-03	0.514901E-03	0.719811E 01
0.360	0.50	1.1015	0.0008900	0.0004362	0.1615E 07	0.2621E 07	0.9147	0.1000E 01	0.476940E-03	0.470038E-03	0.146835E 01
0.190	0.50	1.9060	0.0015400	0.0007548	0.8521E 06	0.1383E 07	0.9147	0.1000E 01	0.825268E-03	0.647005E-03	0.275519E 02
0.240	0.50	1.7699	0.0014300	0.0007009	0.1076E 07	0.1747E 07	0.9147	0.1000E 01	0.766320E-03	0.575677E-03	0.331163E 02
0.300	0.50	1.4728	0.0011900	0.0005833	0.1345E 07	0.2184E 07	0.9147	0.1000E 01	0.637707E-03	0.514901E-03	0.238503E 02
0.360	0.50	1.3243	0.0010700	0.0005245	0.1615E 07	0.2621E 07	0.9147	0.1000E 01	0.573400E-03	0.470038E-03	0.219901E 02

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Table 3. Continued

LAMINAR SHARP CONE DATA FROM VKF 50 IN. HYPERSONIC TUNNEL C

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1008E 02	0.9290E 02	0.5253E 03	0.2652E 00	0.1012E 07	0.1000E 02	0.1667E 01	0.7333E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.1526E 01	0.5732E 01	0.1858E 01	0.9916E 00	0.3059E 01	0.1667E 07

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.305	0.50	1.5213	0.0029700	0.0012347	0.3088E 06	0.5084E 06	0.9103	0.1000E 01	0.135632E-02	0.106733E-02	0.270757E 02
0.406	0.50	1.3010	0.0025400	0.0010559	0.4110E 06	0.6767E 06	0.9103	0.1000E 01	0.115995E-02	0.925096E-03	0.253870E 02
0.711	0.50	0.9937	0.0019400	0.0008065	0.7198E 06	0.1185E 07	0.9103	0.1000E 01	0.885947E-03	0.699061E-03	0.267339E 02
0.812	0.50	0.9117	0.0017800	0.0007400	0.8221E 06	0.1353E 07	0.9103	0.1000E 01	0.812879E-03	0.654141E-03	0.242666E 02
0.914	0.50	0.8503	0.0016600	0.0006901	0.9253E 06	0.1523E 07	0.9103	0.1000E 01	0.758078E-03	0.616561E-03	0.229526E 02

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LAMINAR SHARP CONE DATA FROM VKF 50 IN. HYPERSONIC TUNNEL C

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1020E 02	0.9160E 02	0.5253E 03	0.2630E 00	0.1624E 07	0.1000E 02	0.1667E 01	0.7385E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.2368E 01	0.5840E 01	0.1876E 01	0.9916E 00	0.3087E 01	0.2673E 07

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.305	0.50	1.9255	0.0023500	0.0009672	0.4953E 06	0.8153E 06	0.9098	0.1000E 01	0.106308E-02	0.842814E-03	0.261342E 02
0.406	0.50	1.6551	0.0020200	0.0008314	0.6593E 06	0.1085E 07	0.9098	0.1000E 01	0.913793E-03	0.730498E-03	0.250919E 02
0.711	0.50	1.2536	0.0015300	0.0006297	0.1155E 07	0.1901E 07	0.9098	0.1000E 01	0.692131E-03	0.552010E-03	0.253838E 02
0.812	0.50	1.1471	0.0014000	0.0005762	0.1319E 07	0.2171E 07	0.9098	0.1000E 01	0.633322E-03	0.516539E-03	0.226086E 02
0.914	0.50	1.0734	0.0013100	0.0005392	0.1484E 07	0.2443E 07	0.9098	0.1000E 01	0.592609E-03	0.486865E-03	0.217193E 02

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Table 3. Continued

LAMINAR SHARP CONE OATA FROM VKF 108 IN. HYPERVELOCITY TUNNEL F

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(OEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1606E 02	0.1622E 03	0.5400E 03	0.6331E-01	0.1669E 06	0.5000E 01	0.1667E 01	0.1267E 02	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.3650E 00	0.4124E 01	0.1593E 01	0.9955E 00	0.2577E 01	0.2734E 06

EXPERIMENTAL OATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EOGE PARA	T.E.P.	P.E.
0.305	0.50	3.8923	0.0048000	0.0022378	0.5090E 05	0.8340E 05	0.7658	0.1000E 01	0.292227E-02	0.263512E-02	0.108969E 02
0.406	0.50	3.7058	0.0045700	0.0021306	0.6775E 05	0.1110E 06	0.7658	0.1000E 01	0.278224E-02	0.228396E-02	0.218168E 02
0.500	0.50	3.2193	0.0039700	0.0018509	0.8344E 05	0.1367E 06	0.7658	0.1000E 01	0.241696E-02	0.205810E-02	0.174366E 02
0.602	0.50	3.0895	0.0038100	0.0017763	0.1005E 06	0.1646E 06	0.7658	0.1000E 01	0.231955E-02	0.187565E-02	0.236662E 02
0.702	0.50	2.9030	0.0035800	0.0016690	0.1171E 06	0.1920E 06	0.7658	0.1000E 01	0.217952E-02	0.173693E-02	0.254813E 02
0.803	0.50	2.8462	0.0035100	0.0016364	0.1340E 06	0.2196E 06	0.7658	0.1000E 01	0.213691E-02	0.162403E-02	0.315808E 02
0.904	0.50	2.3759	0.0029300	0.0013660	0.1509E 06	0.2472E 06	0.7658	0.1000E 01	0.178380E-02	0.153062E-02	0.165412E 02

LAMINAR SHARP CONE OATA FROM VKF 108 IN. HYPERVELOCITY TUNNEL F

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(OEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1076E 02	0.9860E 02	0.5400E 03	0.2267E 00	0.1359E 08	0.6300E 01	0.1707E 01	0.8914E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.2055E 02	0.3280E 01	0.1451E 01	0.9979E 00	0.2256E 01	0.2113E 08

EXPERIMENTAL OATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EOGE PARA	T.E.P.	P.E.
0.378	0.50	4.7500	0.0005252	0.0002921	0.5136E 07	0.7986E 07	0.8980	0.1000E 01	0.325315E-03	0.269289E-03	0.208051E 02
0.378	0.50	3.9500	0.0004368	0.0002429	0.5136E 07	0.7986E 07	0.8980	0.1000E 01	0.270525E-03	0.269289E-03	0.459023E 00

Table 3. Continued

LAMINAR SHARP CONE DATA FROM VKF 108 IN. HYPERVELOCITY TUNNEL F

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1065E 02	0.1121E 03	0.5400E 03	0.2034E 00	0.1043E 08	0.6300E 01	0.1707E 01	0.8845E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.1931E 02	0.3238E 01	0.1444E 01	0.9979E 00	0.2238E 01	0.1617E 08

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.378	0.50	5.3500	0.0005906	0.0003287	0.3943E 07	0.6112E 07	0.8883	0.1000E 01	0.369992E-03	0.307826E-03	0.201953E 02
0.378	0.50	4.9000	0.0005409	0.0003010	0.3943E 07	0.6112E 07	0.8883	0.1000E 01	0.338871E-03	0.307826E-03	0.100854E 02
0.581	0.50	4.9000	0.0005409	0.0003010	0.6060E 07	0.9394E 07	0.8883	0.1000E 01	0.338871E-03	0.248293E-03	0.364804E 02

LAMINAR SHARP CONE DATA FROM VKF 108 IN. HYPERVELOCITY TUNNEL F

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1057E 02	0.1198E 03	0.5400E 03	0.1931E 00	0.8569E 07	0.6300E 01	0.1707E 01	0.8794E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.1768E 02	0.3207E 01	0.1438E 01	0.9979E 00	0.2225E 01	0.1325E 08

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.378	0.50	5.3000	0.0006238	0.0003481	0.3239E 07	0.5010E 07	0.8834	0.1000E 01	0.394043E-03	0.339993E-03	0.158973E 02
0.378	0.50	4.5000	0.0005296	0.0002956	0.3239E 07	0.5010E 07	0.8834	0.1000E 01	0.334565E-03	0.339993E-03	-0.159663E 01

Table 3. Continued

LAMINAR SHARP CONE DATA FROM VKF 108 IN. HYPERVELOCITY TUNNEL F

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1056E 02	0.1264E 03	0.5400E 03	0.1833E 00	0.6982E 07	0.6300E 01	0.1707E 01	0.8788E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.1558E 02	0.3203E 01	0.1438E 01	0.9979E 00	0.2223E 01	0.1086E 08

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.378	0.50	4.7000	0.0006055	0.0003372	0.2639E 07	0.4103E 07	0.8809	0.1000E 01	0.382764E-03	0.375683E-03	0.188460E 01
0.479	0.50	4.2000	0.0005411	0.0003013	0.3344E 07	0.5200E 07	0.8809	0.1000E 01	0.342044E-03	0.333734E-03	0.249014E 01

LAMINAR SHARP CONE DATA FROM VKF 108 IN. HYPERVELOCITY TUNNEL F

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1058E 02	0.1280E 03	0.5400E 03	0.1804E 00	0.6060E 07	0.6300E 01	0.1707E 01	0.8801E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.1380E 02	0.3211E 01	0.1439E 01	0.9979E 00	0.2226E 01	0.9424E 07

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.378	0.50	4.7000	0.0006731	0.0003740	0.2291E 07	0.3562E 07	0.8792	0.1000E 01	0.425343E-03	0.403193E-03	0.549361E 01
0.479	0.50	3.7000	0.0005299	0.0002944	0.2903E 07	0.4514E 07	0.8792	0.1000E 01	0.334844E-03	0.358172E-03	-0.651282E 01

Table 3. Continued

LAMINAR SHARP CONE DATA FROM VKF 108 IN. HYPERVELOCITY TUNNEL F

MINF	TINF(R)	TW(R)	TW/TO	REINFL5	THETA(OEG)	L5(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1670E 02	0.8077E 02	0.5400E 03	0.1178E 00	0.1916E 07	0.1000E 02	0.1667E 01	0.9271E 01	0.1000E 01	0.1000E 01

PINF(P5F)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REEL5
0.1418E 01	0.1358E 02	0.3130E 01	0.9822E 00	0.4260E 01	0.2639E 07

EXPERIMENTAL OATA

X/L	N	QDOT	5TINF	5TEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.305	0.50	5.3366	0.0022700	0.0006482	0.5845E 06	0.8049E 06	0.8385	0.1000E 01	0.773017E-03	0.848216E-03	-0.886562E 01
0.406	0.50	4.1376	0.0017600	0.0005026	0.7781E 06	0.1071E 07	0.8385	0.1000E 01	0.599343E-03	0.735180E-03	-0.184766E 02
0.711	0.50	3.1972	0.0013600	0.0003884	0.1363E 07	0.1876E 07	0.8385	0.1000E 01	0.463129E-03	0.555548E-03	-0.166357E 02
0.914	0.50	2.7976	0.0011900	0.0003398	0.1752E 07	0.2412E 07	0.8385	0.1000E 01	0.405238E-03	0.489986E-03	-0.172961E 02

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LAMINAR SHARP CONE DATA FROM VKF 108 IN. HYPERVELOCITY TUNNEL F

MINF	TINF(R)	TW(R)	TW/TO	REINFL5	THETA(DEG)	L5(FT)	ME	ALT(FT)	UINF(FT/5EC)
0.1702E 02	0.1166E 03	0.5400E 03	0.7858E-01	0.1974E 06	0.1000E 02	0.1667E 01	0.9328E 01	0.1000E 01	0.1000E 01

PINF(P5F)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REEL5
0.2490E 00	0.1405E 02	0.3208E 01	0.9816E 00	0.4301E 01	0.2792E 06

EXPERIMENTAL OATA

X/L	N	QDOT	5TINF	5TEAW	REINFL	REEL	CSTAREN	ROSTROE	EOGE PARA	T.E.P.	P.E.
0.305	0.50	4.7403	0.0086500	0.0024244	0.6020E 05	0.8517E 05	0.8056	0.1000E 01	0.300957E-02	0.260761E-02	0.154151E 02
0.406	0.50	4.1046	0.0074900	0.0020993	0.8013E 05	0.1134E 06	0.8056	0.1000E 01	0.260598E-02	0.226011E-02	0.153032E 02
0.710	0.50	3.4525	0.0063000	0.0017658	0.1401E 06	0.1983E 06	0.8056	0.1000E 01	0.219194E-02	0.170908E-02	0.282526E 02
0.812	0.50	3.0963	0.0056500	0.0015836	0.1603E 06	0.2267E 06	0.8056	0.1000E 01	0.196579E-02	0.159814E-02	0.230051E 02
0.914	0.50	2.9374	0.0053600	0.0015023	0.1804E 06	0.2552E 06	0.8056	0.1000E 01	0.186489E-02	0.150633E-02	0.238040E 02

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Table 3. Continued

LAMINAR SHARP CONE OATA FROM VKF LOW OENSITY HYPERSONIC TUNNEL M

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(OEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1820E 02	0.8100E 02	0.5400E 03	0.9914E-01	0.1440E 05	0.1000E 02	0.9600E 00	0.9522E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.1670E-01	0.1589E 02	0.3507E 01	0.9797E 00	0.4440E 01	0.1861E 05

EXPERIMENTAL OATA

X/L	N	QOOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EOGE PARA	T.E.P.	P.E.
0.223	0.50	1.4983	0.0410000	0.0111841	0.3211E 04	0.4149E 04	0.8227	0.1000E 01	0.135952E-01	0.118138E-01	0.150794E 02
0.285	0.50	1.3521	0.0370000	0.0100930	0.4104E 04	0.5303E 04	0.8227	0.1000E 01	0.122688E-01	0.104501E-01	0.174045E 02
0.346	0.50	1.2790	0.0350000	0.0095474	0.4982E 04	0.6438E 04	0.8227	0.1000E 01	0.116057E-01	0.948425E-02	0.223678E 02
0.438	0.50	1.0232	0.0280000	0.0076379	0.6307E 04	0.8150E 04	0.8227	0.1000E 01	0.928453E-02	0.842953E-02	0.101428E 02
0.720	0.50	0.8771	0.0240000	0.0065468	0.1037E 05	0.1340E 05	0.8227	0.1000E 01	0.795817E-02	0.657468E-02	0.210427E 02
0.853	0.50	0.8771	0.0240000	0.0065468	0.1228E 05	0.1587E 05	0.8227	0.1000E 01	0.795817E-02	0.604040E-02	0.317489E 02
0.985	0.50	0.8040	0.0220000	0.0060012	0.1418E 05	0.1833E 05	0.8227	0.1000E 01	0.729499E-02	0.562111E-02	0.297783E 02

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LAMINAR SHARP CONE OATA FROM VKF LOW OENSITY HYPERSONIC TUNNEL M

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(OEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1860E 02	0.6300E 02	0.5400E 03	0.1221E 00	0.1290E 05	0.1000E 02	0.9600E 00	0.9581E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.1170E-01	0.1654E 02	0.3613E 01	0.9791E 00	0.4483E 01	0.1612E 05

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.223	0.50	0.8919	0.0380000	0.0103219	0.2877E 04	0.3595E 04	0.8420	0.1000E 01	0.122591E-01	0.126921E-01	-0.341171E 01
0.285	0.50	0.8450	0.0360000	0.0097787	0.3677E 04	0.4595E 04	0.8420	0.1000E 01	0.116138E-01	0.112270E-01	0.344591E 01
0.346	0.50	0.7511	0.0320000	0.0086922	0.4464E 04	0.5578E 04	0.8420	0.1000E 01	0.103234E-01	0.101894E-01	0.131556E 01
0.438	0.50	0.6337	0.0270000	0.0073340	0.5651E 04	0.7061E 04	0.8420	0.1000E 01	0.871038E-02	0.905624E-02	-0.381902E 01
0.720	0.50	0.5164	0.0220000	0.0059759	0.9290E 04	0.1161E 05	0.8420	0.1000E 01	0.709734E-02	0.706348E-02	0.479408E 00
0.853	0.50	0.4929	0.0210000	0.0057042	0.1101E 05	0.1375E 05	0.8420	0.1000E 01	0.677474E-02	0.648948E-02	0.439568E 01

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Table 3. Concluded

LAMINAR SHARP CONE DATA FROM VKF LOW DENSITY HYPERSONIC TUNNEL M

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1990E 02	0.5940E 02	0.5400E 03	0.1134E 00	0.1106E 05	0.1000E 02	0.9600E 00	0.9760E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.7240E-02	0.1876E 02	0.3973E 01	0.9777E 00	0.4615E 01	0.1295E 05

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.223	0.50	0.8010	0.0460000	0.0121129	0.2466E 04	0.2888E 04	0.8346	0.1000E 01	0.145128E-01	0.141613E-01	0.248233E 01
0.285	0.50	0.6965	0.0400000	0.0105330	0.3152E 04	0.3691E 04	0.8346	0.1000E 01	0.126198E-01	0.125266E-01	0.744430E 00
0.346	0.50	0.6269	0.0360000	0.0094797	0.3826E 04	0.4481E 04	0.8346	0.1000E 01	0.113578E-01	0.113688E-01	-0.967626E-01
0.438	0.50	0.5224	0.0300000	0.0078997	0.4844E 04	0.5672E 04	0.8346	0.1000E 01	0.946486E-02	0.101046E-01	-0.633076E 01
0.720	0.50	0.4179	0.0240000	0.0063198	0.7963E 04	0.9324E 04	0.8346	0.1000E 01	0.757188E-02	0.788112E-02	-0.392381E 01

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Table 4. Statistical Analysis of Laminar Correlation

Source	Sample Size, n	$\bar{L}$	σ	E
Flight Data	170	15.65	11.6	0.60
Princeton N-3 and N-5 Tunnel	95	-6.42	8.8	0.61
NOL Hypersonic* Tunnel	15	-2.80	4.0	0.72
NASA - Langley 11-inch Hypersonic	41	13.80	8.9	0.95
VKF Hypersonic Tunnel B	34	8.49	10.4	1.22
VKF Hypersonic Tunnel C	28	19.97	9.5	1.24
VKF Hypervelocity Tunnel F	27	11.02	15.0	1.98
VKF Low Density Hypersonic Tunnel M (Contoured Nozzle)	7	21.08	7.2	1.97
VKF Low Density Hypersonic Tunnel M (Conical Nozzle)	11	-0.43	3.3	0.70

*T_w/T_o = 0.11 data not included in calculation.

E, most probable error of the mean, see Eq. (33)

σ, standard deviation, see Eq. (32)

$\bar{L}$, mean of a group, see Eq. (31)

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Table 5. Turbulent Flight Data

REENTRY F TURB. DATA AT 90000 FT. 180 DEG. RAY. ALPHA EQUALS .10 DEG.

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.2002E 02	0.4022E 03	0.8210E 03	0.2515E-01	0.4507E 08	0.5000E 01	0.1305E 02	0.1457E 02	0.9000E 05	0.1969E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.3694E 02	0.5725E 01	0.1857E 01	0.9916E 00	0.3058E 01	0.8572E 08

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.924	0.16	215.00	0.0008310	0.0003056	0.4165E 08	0.7920E 08	0.8869	0.2328E 00	0.148000E-02	0.132920E-02	0.113454E 02

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REENTRY F TURB. DATA AT 89000 FT. 180 DEG. RAY. ALPHA EQUALS .06 DEG.

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.2002E 02	0.4016E 03	0.8380E 03	0.2570E-01	0.4735E 08	0.5000E 01	0.1305E 02	0.1457E 02	0.8900E 05	0.1968E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.3871E 02	0.5728E 01	0.1857E 01	0.9916E 00	0.3058E 01	0.9003E 08

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.924	0.16	222.00	0.0008192	0.0003012	0.4375E 08	0.8318E 08	0.8872	0.2320E 00	0.146335E-02	0.131882E-02	0.109590E 02

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Table 5. Continued

REENTRY F TURB. DATA AT 87000 FT. 180 DEG. RAY. ALPHA EQUALS 0 DEG.

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.2004E 02	0.4003E 03	0.8770E 03	0.2695E-01	0.5232E 08	0.5000E 01	0.1305E 02	0.1458E 02	0.8700E 05	0.1966E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.4257E 02	0.5734E 01	0.1858E 01	0.9915E 00	0.3060E 01	0.9947E 08

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.924	0.16	235.00	0.0007893	0.0002901	0.4835E 08	0.9191E 08	0.8878	0.2304E 00	0.141867E-02	0.129794E-02	0.930175E 01

REENTRY F TURB. DATA AT 87000 FT. ZERO DEG. RAY. ALPHA EQUALS 0 DEG.

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.2004E 02	0.4003E 03	0.8790E 03	0.2701E-01	0.5232E 08	0.5000E 01	0.1305E 02	0.1458E 02	0.8700E 05	0.1966E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.4257E 02	0.5734E 01	0.1858E 01	0.9915E 00	0.3060E 01	0.9947E 08

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.924	0.16	260.00	0.0008733	0.0003210	0.4835E 08	0.9191E 08	0.8878	0.2303E 00	0.156985E-02	0.129794E-02	0.209496E 02

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Table 5. Continued

REENTRY F TURB. DATA AT 86000 FT. 180 DEG. RAY. ALPHA EQUALS -.02 DEG.

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.2004E 02	0.3997E 03	0.8810E 03	0.2710E-01	0.5595E 08	0.5000E 01	0.1305E 02	0.1458E 02	0.8600E 05	0.1965E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.4542E 02	0.5735E 01	0.1858E 01	0.9915E 00	0.3060E 01	0.1063E 09

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.924	0.16	235.00	0.0007401	0.0002720	0.5170E 08	0.9826E 08	0.8883	0.2295E 00	0.133420E-02	0.128414E-02	0.389870E 01

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REENTRY F TURB. DATA AT 86000 FT. ZERO DEG. RAY. ALPHA EQUALS -.02 DEG.

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.2004E 02	0.3997E 03	0.8870E 03	0.2729E-01	0.5595E 08	0.5000E 01	0.1305E 02	0.1458E 02	0.8600E 05	0.1965E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.4542E 02	0.5735E 01	0.1858E 01	0.9915E 00	0.3060E 01	0.1063E 09

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.853	0.16	268.00	0.0008441	0.0003103	0.4772E 08	0.9071E 08	0.8876	0.2304E 00	0.151727E-02	0.130067E-02	0.166529E 02
0.924	0.16	262.00	0.0008252	0.0003033	0.5170E 08	0.9826E 08	0.8883	0.2294E 00	0.148824E-02	0.128414E-02	0.158940E 02

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Table 5. Continued

REENTRY F TURB. DATA AT 84000 FT. 180 DEG. RAY. ALPHA EQUALS -.08 DEG.

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.2005E 02	0.3985E 03	0.9180E 03	0.2830E-01	0.5999E 08	0.5000E 01	0.1305E 02	0.1458E 02	0.8400E 05	0.1963E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.4849E 02	0.5739E 01	0.1859E 01	0.9915E 00	0.3061E 01	0.1140E 09

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.924	0.16	250.00	0.0007387	0.0002714	0.5543E 08	0.1053E 09	0.8887	0.2283E 00	0.133814E-02	0.126995E-02	0.537026E 01

REENTRY F TURB. DATA AT 84000 FT. ZERO DEG. RAY. ALPHA EQUALS -.08 DEG.

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.2005E 02	0.3985E 03	0.9340E 03	0.2880E-01	0.5999E 08	0.5000E 01	0.1305E 02	0.1458E 02	0.8400E 05	0.1963E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.4849E 02	0.5739E 01	0.1859E 01	0.9915E 00	0.3061E 01	0.1140E 09

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.853	0.16	289.00	0.0008543	0.0003140	0.5117E 08	0.9723E 08	0.8879	0.2290E 00	0.154386E-02	0.128630E-02	0.200239E 02
0.924	0.16	271.00	0.0008011	0.0002944	0.5543E 08	0.1053E 09	0.8886	0.2281E 00	0.145249E-02	0.126995E-02	0.143745E 02

Table 5. Continued

REENTRY F TURB. DATA AT 83000 FT. 180 DEG. RAY. ALPHA EQUALS -.08 DEG.

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.2005E 02	0.3979E 03	0.9290E 03	0.2868E-01	0.6307E 08	0.5000E 01	0.1305E 02	0.1458E 02	0.8300E 05	0.1961E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.5088E 02	0.5739E 01	0.1859E 01	0.9915E 00	0.3061E 01	0.1198E 09

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.924	0.16	255.00	0.0007188	0.0002641	0.5827E 08	0.1107E 09	0.8890	0.2276E 00	0.130556E-02	0.125985E-02	0.362834E 01

REENTRY F TURB. DATA AT 83000 FT. ZERO DEG. RAY. ALPHA EQUALS -.08 DEG.

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.2005E 02	0.3979E 03	0.9570E 03	0.2954E-01	0.6307E 08	0.5000E 01	0.1305E 02	0.1458E 02	0.8300E 05	0.1961E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.5088E 02	0.5739E 01	0.1859E 01	0.9915E 00	0.3061E 01	0.1198E 09

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.924	0.16	281.00	0.0007928	0.0002914	0.5827E 08	0.1107E 09	0.8889	0.2273E 00	0.144206E-02	0.125985E-02	0.144632E 02

Table 5. Continued

REENTRY F TURB. DATA AT 82000 FT. 180 DEG. RAY. ALPHA EQUALS -.10 DEG.

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.2005E 02	0.3974E 03	0.9610E 03	0.2971E-01	0.6622E 08	0.5000E 01	0.1305E 02	0.1458E 02	0.8200E 05	0.1960E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.5332E 02	0.5739E 01	0.1859E 01	0.9915E 00	0.3061E 01	0.1258E 09

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.776	0.16	295.00	0.0007948	0.0002921	0.5139E 08	0.9761E 08	0.8879	0.2287E 00	0.143870E-02	0.128549E-02	0.119185E 02
0.924	0.15	264.00	0.0007113	0.0002614	0.6119E 08	0.1162E 09	0.8892	0.2267E 00	0.129678E-02	0.125008E-02	0.373564E 01

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REENTRY F TURB. DATA AT 82000 FT. ZERO DEG. RAY. ALPHA EQUALS -.1 DEG.

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.2005E 02	0.3974E 03	0.9800E 03	0.3030E-01	0.6622E 08	0.5000E 01	0.1305E 02	0.1458E 02	0.8200E 05	0.1960E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.5332E 02	0.5739E 01	0.1859E 01	0.9915E 00	0.3061E 01	0.1258E 09

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.853	0.16	305.00	0.0008223	0.0003022	0.5649E 08	0.1073E 09	0.8885	0.2274E 00	0.149568E-02	0.126618E-02	0.181254E 02
0.924	0.15	285.00	0.0007683	0.0002824	0.6119E 08	0.1162E 09	0.8892	0.2265E 00	0.140217E-02	0.125008E-02	0.121665E 02

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Table 5. Continued

REENTRY F TURB. DATA AT 81000 FT. 180 DEG. RAY. ALPHA EQUALS -.12 DEG.

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.2005E 02	0.3968E 03	0.9750E 03	0.3019E-01	0.6952E 08	0.5000E 01	0.1305E 02	0.1458E 02	0.8100E 05	0.1959E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.5587E 02	0.5739E 01	0.1859E 01	0.9915E 00	0.3061E 01	0.1320E 09

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.776	0.16	304.00	0.0007826	0.0002877	0.5395E 08	0.1025E 09	0.8882	0.2280E 00	0.142058E-02	0.127557E-02	0.113687E 02
0.924	0.15	272.00	0.0007002	0.0002574	0.6424E 08	0.1220E 09	0.8896	0.2260E 00	0.128014E-02	0.124043E-02	0.320103E 01

REENTRY F TURB. DATA AT 81000 FT. ZERO DEG. RAY. ALPHA EQUALS -.12 DEG.

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.2005E 02	0.3968E 03	0.9930E 03	0.3074E-01	0.6952E 08	0.5000E 01	0.1305E 02	0.1458E 02	0.8100E 05	0.1959E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.5587E 02	0.5739E 01	0.1859E 01	0.9915E 00	0.3061E 01	0.1320E 09

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.853	0.16	310.00	0.0007985	0.0002935	0.5930E 08	0.1126E 09	0.8889	0.2267E 00	0.145646E-02	0.125640E-02	0.159233E 02
0.924	0.15	293.00	0.0007547	0.0002774	0.6424E 08	0.1220E 09	0.8895	0.2258E 00	0.138107E-02	0.124043E-02	0.113375E 02

Table 5. Continued

REENTRY F TURB. DATA AT 80000 FT. 180 DEG. RAY. ALPHA EQUALS -.15 DEG.

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.2005E 02	0.3963E 03	0.9950E 03	0.3085E-01	0.7295E 08	0.5000E 01	0.1305E 02	0.1458E 02	0.8000E 05	0.1957E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.5852E 02	0.5739E 01	0.1859E 01	0.9915E 00	0.3061E 01	0.1385E 09

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.776	0.16	312.00	0.0007680	0.0002823	0.5661E 08	0.1075E 09	0.8885	0.2272E 00	0.139830E-02	0.126582E-02	0.104666E 02
0.924	0.15	286.00	0.0007040	0.0002588	0.6741E 08	0.1280E 09	0.8898	0.2253E 00	0.129090E-02	0.123095E-02	0.486979E 01

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REENTRY F TURB. DATA AT 80000 FT. ZERO DEG. RAY. ALPHA EQUALS -.15 DEG.

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.2005E 02	0.3963E 03	0.1013E 04	0.3141E-01	0.7295E 08	0.5000E 01	0.1305E 02	0.1458E 02	0.8000E 05	0.1957E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.5852E 02	0.5739E 01	0.1859E 01	0.9915E 00	0.3061E 01	0.1385E 09

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.853	0.15	319.00	0.0007857	0.0002888	0.6223E 08	0.1182E 09	0.8892	0.2260E 00	0.143739E-02	0.124680E-02	0.152863E 02
0.924	0.15	298.00	0.0007339	0.0002698	0.6741E 08	0.1280E 09	0.8898	0.2251E 00	0.134711E-02	0.123095E-02	0.943625E 01

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Table 5. Continued

REENTRY F TURB. OATA AT 79000 FT. 180 DEG. RAY. ALPHA EQUALS -.18 DEG.

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.2005E 02	0.3957E 03	0.1024E 04	0.3180E-01	0.7662E 08	0.5000E 01	0.1305E 02	0.1458E 02	0.7900E 05	0.1955E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.6136E 02	0.5737E 01	0.1859E 01	0.9915E 00	0.3061E 01	0.1455E 09

EXPERIMENTAL OATA

X/L	N	QOOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.776	0.16	321.00	0.0007552	0.0002777	0.5946E 08	0.1129E 09	0.8888	0.2264E 00	0.137990E-02	0.125594E-02	0.986981E 01
0.924	0.15	298.00	0.0007010	0.0002578	0.7080E 08	0.1344E 09	0.8901	0.2245E 00	0.129009E-02	0.122135E-02	0.562846E 01

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REENTRY F TURB. OATA AT 79000 FT. ZERO OEG. RAY. ALPHA EQUALS -.18 OEG.

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(OEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.2005E 02	0.3957E 03	0.1009E 04	0.3134E-01	0.7662E 08	0.5000E 01	0.1305E 02	0.1458E 02	0.7900E 05	0.1955E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.6136E 02	0.5737E 01	0.1859E 01	0.9915E 00	0.3061E 01	0.1455E 09

EXPERIMENTAL OATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EOGE PARA	T.E.P.	P.E.
0.776	0.16	340.00	0.0007995	0.0002939	0.5946E 08	0.1129E 09	0.8888	0.2266E 00	0.145973E-02	0.125594E-02	0.162258E 02
0.853	0.15	325.00	0.0007642	0.0002810	0.6536E 08	0.1241E 09	0.8896	0.2255E 00	0.140070E-02	0.123707E-02	0.132267E 02
0.924	0.15	305.00	0.0007172	0.0002637	0.7080E 08	0.1344E 09	0.8902	0.2246E 00	0.131872E-02	0.122135E-02	0.797247E 01

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Table 5. Continued

REENTRY F TURB. DATA AT 78000 FT. 180 DEG. RAY. ALPHA EQUALS -.2 DEG.

MINF	TINF(R)	TW(R)	TW/TD	REINFL5	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.2004E 02	0.3952E 03	0.1041E 04	0.3239E-01	0.8044E 08	0.5000E 01	0.1305E 02	0.1458E 02	0.7800E 05	0.1954E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REEL5
0.6432E 02	0.5736E 01	0.1858E 01	0.9915E 00	0.3060E 01	0.1527E 09

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTRDE	EDGE PARA	T.E.P.	P.E.
0.776	0.15	338.00	0.0007600	0.0002795	0.6242E 08	0.1185E 09	0.8891	0.2257E 00	0.139292E-02	0.124625E-02	0.117685E 02
0.924	0.15	314.00	0.0007061	0.0002597	0.7433E 08	0.1411E 09	0.8904	0.2238E 00	0.130312E-02	0.121192E-02	0.752457E 01

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REENTRY F TURB. DATA AT 78000 FT. ZERO DEG. RAY. ALPHA EQUALS -.2 DEG.

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	L5(FT)	ME	ALT(FT)	UINF(FT/5EC)
0.2004E 02	0.3952E 03	0.1034E 04	0.3217E-01	0.8044E 08	0.5000E 01	0.1305E 02	0.1458E 02	0.7800E 05	0.1954E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	RDUE/ROUINF	REEL5
0.6432E 02	0.5736E 01	0.1858E 01	0.9915E 00	0.3060E 01	0.1527E 09

EXPERIMENTAL DATA

X/L	N	QDOT	5TINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.776	0.15	350.00	0.0007869	0.0002894	0.6242E 08	0.1185E 09	0.8891	0.2258E 00	0.144152E-02	0.124625E-02	0.156683E 02
0.853	0.15	330.00	0.0007419	0.0002728	0.6862E 08	0.1302E 09	0.8898	0.2247E 00	0.136434E-02	0.122753E-02	0.111457E 02
0.924	0.15	309.00	0.0006947	0.0002555	0.7433E 08	0.1411E 09	0.8905	0.2239E 00	0.128160E-02	0.121192E-02	0.574951E 01

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Table 5. Continued

REENTRY F TURB. DATA AT 77000 FT. 180 DEG. RAY. ALPHA EQUALS -.33 DEG.

MINF	TINF(R)	TW(R)	TW/TD	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.2004E 02	0.3947E 03	0.1059E 04	0.3300E-01	0.8448E 08	0.5000E 01	0.1305E 02	0.1458E 02	0.7700E 05	0.1952E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	RDUE/RDUINF	REELS
0.6743E 02	0.5734E 01	0.1858E 01	0.9915E 00	0.3060E 01	0.1603E 09

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	RDSTRDE	EDGE PARA	T.E.P.	P.E.
0.776	0.15	349.00	0.0007498	0.0002758	0.6555E 08	0.1244E 09	0.8894	0.2250E 00	0.137828E-02	0.123656E-02	0.114606E 02
0.924	0.15	327.00	0.0007025	0.0002584	0.7806E 08	0.1481E 09	0.8907	0.2231E 00	0.130043E-02	0.120250E-02	0.814345E 01

REENTRY F TURB. DATA AT 77000 FT. ZERO DEG. RAY. ALPHA EQUALS -.33 DEG.

MINF	TINF(R)	TW(R)	TW/TD	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.2004E 02	0.3947E 03	0.1056E 04	0.3291E-01	0.8448E 08	0.5000E 01	0.1305E 02	0.1458E 02	0.7700E 05	0.1952E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	RDUE/RDUINF	REELS
0.6743E 02	0.5734E 01	0.1858E 01	0.9915E 00	0.3060E 01	0.1603E 09

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	RDSTRDE	EDGE PARA	T.E.P.	P.E.
0.776	0.15	355.00	0.0007626	0.0002805	0.6555E 08	0.1244E 09	0.8894	0.2250E 00	0.140162E-02	0.123656E-02	0.133480E 02
0.853	0.15	335.00	0.0007197	0.0002647	0.7206E 08	0.1367E 09	0.8901	0.2240E 00	0.132769E-02	0.121799E-02	0.900675E 01
0.924	0.15	318.00	0.0006831	0.0002513	0.7806E 08	0.1481E 09	0.8907	0.2231E 00	0.126431E-02	0.120250E-02	0.514013E 01

Table 5. Continued

REENTRY F TURB. DATA AT 76000 FT. 180 DEG. RAY. ALPHA EQUALS -.38 DEG.

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.2003E 02	0.3941E 03	0.1083E 04	0.3382E-01	0.8861E 08	0.5000E 01	0.1305E 02	0.1457E 02	0.7600E 05	0.1950E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.7064E 02	0.5731E 01	0.1858E 01	0.9916E 00	0.3059E 01	0.1681E 09

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.776	0.15	360.00	0.0007403	0.0002724	0.6876E 08	0.1305E 09	0.8897	0.2243E 00	0.136522E-02	0.122719E-02	0.112482E 02
0.924	0.15	345.00	0.0007094	0.0002611	0.8188E 08	0.1553E 09	0.8910	0.2224E 00	0.131744E-02	0.119338E-02	0.103952E 02

REENTRY F TURB. DATA AT 76000 FT. ZERO DEG. RAY. ALPHA EQUALS -.38 DEG.

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.2003E 02	0.3941E 03	0.1080E 04	0.3373E-01	0.8861E 08	0.5000E 01	0.1305E 02	0.1457E 02	0.7600E 05	0.1950E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.7064E 02	0.5731E 01	0.1858E 01	0.9916E 00	0.3059E 01	0.1681E 09

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.776	0.15	359.00	0.0007382	0.0002716	0.6876E 08	0.1305E 09	0.8897	0.2243E 00	0.136108E-02	0.122719E-02	0.109109E 02
0.853	0.15	338.00	0.0006950	0.0002557	0.7559E 08	0.1434E 09	0.8904	0.2233E 00	0.128632E-02	0.120875E-02	0.641701E 01
0.924	0.15	320.00	0.0006580	0.0002421	0.8188E 08	0.1553E 09	0.8910	0.2224E 00	0.122166E-02	0.119338E-02	0.236941E 01

Table 5. Continued

REENTRY F TURB. DATA AT 75000 FT. 180 DEG. RAY. ALPHA EQUALS -.4 DEG.

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.2002E 02	0.3936E 03	0.1110E 04	0.3473E-01	0.9300E 08	0.5000E 01	0.1305E 02	0.1457E 02	0.7500E 05	0.1948E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.7404E 02	0.5728E 01	0.1857E 01	0.9916E 00	0.3058E 01	0.1764E 09

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.776	0.15	378.00	0.0007437	0.0002738	0.7217E 08	0.1369E 09	0.8900	0.2235E 00	0.137618E-02	0.121778E-02	0.130070E 02
0.924	0.15	361.00	0.0007102	0.0002615	0.8593E 08	0.1630E 09	0.8913	0.2217E 00	0.132338E-02	0.118424E-02	0.117493E 02

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REENTRY F TURB. DATA AT 75000 FT. ZERO DEG. RAY. ALPHA EQUALS -.4 DEG.

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.2002E 02	0.3936E 03	0.1091E 04	0.3414E-01	0.9300E 08	0.5000E 01	0.1305E 02	0.1457E 02	0.7500E 05	0.1948E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.7404E 02	0.5728E 01	0.1857E 01	0.9916E 00	0.3058E 01	0.1764E 09

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.776	0.15	364.00	0.0007157	0.0002634	0.7217E 08	0.1369E 09	0.8901	0.2237E 00	0.132307E-02	0.121778E-02	0.864572E 01
0.853	0.15	344.00	0.0006764	0.0002490	0.7933E 08	0.1505E 09	0.8908	0.2227E 00	0.125508E-02	0.119949E-02	0.463419E 01
0.924	0.15	328.00	0.0006449	0.0002374	0.8593E 08	0.1630E 09	0.8914	0.2218E 00	0.120046E-02	0.118424E-02	0.136935E 01

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Table 5. Continued

REENTRY F TURB. DATA AT 73000 FT. 180 DEG. RAY. ALPHA EQUALS -.54 DEG.

MINF	TINF(R)	TW(R)	TW/TD	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.2001E 02	0.3927E 03	0.1165E 04	0.3661E-01	0.1025E 09	0.5000E 01	0.1305E 02	0.1456E 02	0.7300E 05	0.1944E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	RDUE/RDUINF	REEL5
0.8138E 02	0.5720E 01	0.1856E 01	0.9916E 00	0.3056E 01	0.1943E 09

EXPERIMENTAL DATA

X/L	N	QDDT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTRDE	EDGE PARA	T.E.P.	P.E.
0.635	0.15	447.00	0.0008047	0.0002965	0.6507E 08	0.1234E 09	0.8890	0.2242E 00	0.148745E-02	0.123821E-02	0.201293E 02
0.776	0.15	400.00	0.0007201	0.0002653	0.7952E 08	0.1508E 09	0.8905	0.2220E 00	0.134179E-02	0.119911E-02	0.118993E 02
0.924	0.15	388.00	0.0006985	0.0002574	0.9469E 08	0.1795E 09	0.8918	0.2202E 00	0.131045E-02	0.116608E-02	0.123804E 02

REENTRY F TURB. DATA AT 73000 FT. ZERO DEG. RAY. ALPHA EQUALS -.54 DEG.

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.2001E 02	0.3927E 03	0.1118E 04	0.3513E-01	0.1025E 09	0.5000E 01	0.1305E 02	0.1456E 02	0.7300E 05	0.1944E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/RDUINF	REELS
0.8138E 02	0.5720E 01	0.1856E 01	0.9916E 00	0.3056E 01	0.1943E 09

EXPERIMENTAL DATA

X/L	N	QDDT	STINF	STEAW	REINFL	REEL	C5TAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.699	0.15	400.00	0.0007189	0.0002649	0.7163E 08	0.1358E 09	0.8899	0.2236E 00	0.133087E-02	0.121933E-02	0.914809E 01
0.776	0.15	382.00	0.0006866	0.0002529	0.7952E 08	0.1508E 09	0.8907	0.2225E 00	0.127627E-02	0.119911E-02	0.643502E 01
0.853	0.15	362.00	0.0006506	0.0002397	0.8741E 08	0.1657E 09	0.8914	0.2215E 00	0.121394E-02	0.118109E-02	0.278127E 01
0.924	0.15	340.00	0.0006111	0.0002251	0.9469E 08	0.1795E 09	0.8920	0.2207E 00	0.114370E-02	0.116608E-02	-0.191898E 01

Table 5. Continued

REENTRY F TURB. DATA AT 70000 FT. 180 DEG. RAY. ALPHA EQUALS -.65 DEG.

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1997E 02	0.3913E 03	0.1253E 04	0.3967E-01	0.1184E 09	0.5000E 01	0.1305E 02	0.1454E 02	0.7000E 05	0.1937E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.9379E 02	0.5702E 01	0.1853E 01	0.9916E 00	0.3052E 01	0.2243E 09

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.635	0.15	480.00	0.0007581	0.0002799	0.7519E 08	0.1424E 09	0.8899	0.2220E 00	0.141665E-02	0.121005E-02	0.170735E 02
0.776	0.15	440.00	0.0006949	0.0002565	0.9189E 08	0.1741E 09	0.8914	0.2199E 00	0.130891E-02	0.117185E-02	0.116962E 02
0.924	0.15	430.00	0.0006791	0.0002507	0.1094E 09	0.2073E 09	0.8927	0.2181E 00	0.128777E-02	0.113957E-02	0.130052E 02

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REENTRY F TURB. DATA AT 70000 FT. ZERO DEG. RAY. ALPHA EQUALS -.65 DEG.

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1997E 02	0.3913E 03	0.1189E 04	0.3765E-01	0.1184E 09	0.5000E 01	0.1305E 02	0.1454E 02	0.7000E 05	0.1937E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.9379E 02	0.5702E 01	0.1853E 01	0.9916E 00	0.3052E 01	0.2243E 09

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.699	0.15	426.00	0.0006714	0.0002478	0.8277E 08	0.1568E 09	0.8909	0.2216E 00	0.125515E-02	0.119161E-02	0.533292E 01
0.776	0.15	402.00	0.0006336	0.0002338	0.9189E 08	0.1741E 09	0.8916	0.2205E 00	0.118928E-02	0.117185E-02	0.148805E 01
0.853	0.15	392.00	0.0006178	0.0002280	0.1010E 09	0.1914E 09	0.8923	0.2195E 00	0.116393E-02	0.115424E-02	0.839709E 00
0.924	0.15	362.00	0.0005705	0.0002106	0.1094E 09	0.2073E 09	0.8929	0.2187E 00	0.107814E-02	0.113957E-02	-0.539098E 01

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Table 5. Continued

REENTRY F TURB. DATA AT 67000 FT. 180 DEG. RAY. ALPHA EQUALS -.71 DEG.

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1991E 02	0.3900E 03	0.1348E 04	0.4306E-01	0.1367E 09	0.5000E 01	0.1305E 02	0.1452E 02	0.6700E 05	0.1928E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	RDUE/RDUINF	REELS
0.1081E 03	0.5676E 01	0.1849E 01	0.9917E 00	0.3045E 01	0.2588E 09

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.635	0.15	525.00	0.0007289	0.0002698	0.8683E 08	0.1643E 09	0.8907	0.2199E 00	0.137753E-02	0.118269E-02	0.164742E 02
0.776	0.15	488.00	0.0006775	0.0002508	0.1061E 09	0.2008E 09	0.8922	0.2178E 00	0.129045E-02	0.114535E-02	0.126687E 02
0.924	0.15	485.00	0.0006734	0.0002492	0.1264E 09	0.2391E 09	0.8935	0.2161E 00	0.129101E-02	0.111380E-02	0.159104E 02

REENTRY F TURB. DATA AT 67000 FT. ZERO DEG. RAY. ALPHA EQUALS -.71 DEG.

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1991E 02	0.3900E 03	0.1263E 04	0.4034E-01	0.1367E 09	0.5000E 01	0.1305E 02	0.1452E 02	0.6700E 05	0.1928E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	RDUE/RDUINF	REELS
0.1081E 03	0.5676E 01	0.1849E 01	0.9917E 00	0.3045E 01	0.2588E 09

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.699	0.15	452.00	0.0006258	0.0002315	0.9558E 08	0.1809E 09	0.8918	0.2197E 00	0.118169E-02	0.116466E-02	0.146230E 01
0.776	0.15	431.00	0.0005967	0.0002208	0.1061E 09	0.2008E 09	0.8926	0.2187E 00	0.113132E-02	0.114535E-02	-0.122478E 01
0.853	0.15	425.00	0.0005884	0.0002177	0.1166E 09	0.2208E 09	0.8933	0.2177E 00	0.111958E-02	0.112814E-02	-0.759349E 00
0.924	0.15	400.00	0.0005538	0.0002049	0.1264E 09	0.2391E 09	0.8938	0.2169E 00	0.105688E-02	0.111380E-02	-0.511093E 01

Table 5. Continued

REENTRY F TURB. DATA AT 65000 FT. 180 DEG. RAY. ALPHA EQUALS -.71 DEG.

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1986E 02	0.3893E 03	0.1423E 04	0.4576E-01	0.1504E 09	0.5000E 01	0.1305E 02	0.1450E 02	0.6500E 05	0.1922E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.1189E 03	0.5655E 01	0.1845E 01	0.9917E 00	0.3039E 01	0.2844E 09

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.635	0.15	563.00	0.0007186	0.0002666	0.9550E 08	0.1806E 09	0.8913	0.2185E 00	0.136918E-02	0.116495E-02	0.175316E 02
0.776	0.15	530.00	0.0006765	0.0002510	0.1167E 09	0.2207E 09	0.8927	0.2164E 00	0.129889E-02	0.112816E-02	0.151333E 02
0.924	0.15	526.00	0.0006714	0.0002491	0.1390E 09	0.2628E 09	0.8940	0.2147E 00	0.129754E-02	0.109709E-02	0.182711E 02

REENTRY F TURB. DATA AT 65000 FT. ZERO DEG. RAY. ALPHA EQUALS -.71 DEG.

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1986E 02	0.3893E 03	0.1312E 04	0.4219E-01	0.1504E 09	0.5000E 01	0.1305E 02	0.1450E 02	0.6500E 05	0.1922E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.1189E 03	0.5655E 01	0.1845E 01	0.9917E 00	0.3039E 01	0.2844E 09

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.635	0.15	492.00	0.0006257	0.0002320	0.9550E 08	0.1806E 09	0.8917	0.2195E 00	0.118498E-02	0.116495E-02	0.171982E 01
0.699	0.15	472.00	0.0006002	0.0002226	0.1051E 09	0.1988E 09	0.8924	0.2186E 00	0.114102E-02	0.114718E-02	-0.537332E 00
0.776	0.15	458.00	0.0005824	0.0002160	0.1167E 09	0.2207E 09	0.8932	0.2175E 00	0.111157E-02	0.112816E-02	-0.147048E 01
0.853	0.15	452.00	0.0005748	0.0002131	0.1283E 09	0.2426E 09	0.8939	0.2166E 00	0.110091E-02	0.111122E-02	-0.927935E 00
0.924	0.15	433.00	0.0005506	0.0002042	0.1390E 09	0.2628E 09	0.8944	0.2158E 00	0.105775E-02	0.109709E-02	-0.358569E 01

Table 5. Continued

REENTRY F TURB. DATA AT 63000 FT. 180 DEG. RAY. ALPHA EQUALS -.71 DEG.

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1980E 02	0.3886E 03	0.1494E 04	0.4840E-01	0.1653E 09	0.5000E 01	0.1305E 02	0.1448E 02	0.6300E 05	0.1914E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.1308E 03	0.5629E 01	0.1841E 01	0.9918E 00	0.3033E 01	0.3124E 09

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.635	0.15	600.00	0.0007049	0.0002622	0.1050E 09	0.1984E 09	0.8918	0.2171E 00	0.135372E-02	0.114760E-02	0.179603E 02
0.776	0.15	570.00	0.0006696	0.0002491	0.1283E 09	0.2424E 09	0.8933	0.2151E 00	0.129586E-02	0.111137E-02	0.166009E 02
0.924	0.15	590.00	0.0006931	0.0002578	0.1527E 09	0.2887E 09	0.8945	0.2135E 00	0.135003E-02	0.108076E-02	0.249155E 02

REENTRY F TURB. DATA AT 63000 FT. ZERO DEG. RAY. ALPHA EQUALS -.71 DEG.

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1980E 02	0.3886E 03	0.1378E 04	0.4464E-01	0.1653E 09	0.5000E 01	0.1305E 02	0.1448E 02	0.6300E 05	0.1914E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.1308E 03	0.5629E 01	0.1841E 01	0.9918E 00	0.3033E 01	0.3124E 09

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.635	0.15	510.00	0.0005968	0.0002218	0.1050E 09	0.1984E 09	0.8923	0.2183E 00	0.113899E-02	0.114760E-02	-0.750611E 00
0.699	0.15	496.00	0.0005804	0.0002158	0.1156E 09	0.2184E 09	0.8930	0.2173E 00	0.111178E-02	0.113010E-02	-0.162194E 01
0.776	0.15	489.00	0.0005722	0.0002127	0.1283E 09	0.2424E 09	0.8938	0.2163E 00	0.110039E-02	0.111137E-02	-0.987476E 00
0.853	0.15	486.00	0.0005687	0.0002114	0.1410E 09	0.2665E 09	0.8945	0.2154E 00	0.109748E-02	0.109467E-02	0.256595E 00
0.924	0.15	462.00	0.0005406	0.0002010	0.1527E 09	0.2887E 09	0.8950	0.2146E 00	0.104634E-02	0.108076E-02	-0.318447E 01

Table 5. Concluded

REENTRY F TURB. DATA AT 60000 FT. 180 DEG. RAY. ALPHA EQUALS -.72 DEG.

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1969E 02	0.3879E 03	0.1630E 04	0.5350E-01	0.1902E 09	0.5000E 01	0.1305E 02	0.1443E 02	0.6000E 05	0.1902E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	RDUE/RDUINF	REELS
0.1510E 03	0.5580E 01	0.1833E 01	0.9919E 00	0.3020E 01	0.3590E 09

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTRDE	EDGE PARA	T.E.P.	P.E.
0.468	0.15	742.00	0.0007729	0.0002889	0.8902E 08	0.1680E 09	0.8904	0.2182E 00	0.148698E-02	0.117854E-02	0.261706E 02
0.635	0.15	678.00	0.0007063	0.0002640	0.1208E 09	0.2279E 09	0.8926	0.2151E 00	0.137487E-02	0.112238E-02	0.224955E 02
0.776	0.15	633.00	0.0006594	0.0002464	0.1476E 09	0.2785E 09	0.8940	0.2131E 00	0.129328E-02	0.108694E-02	0.189834E 02
0.924	0.14	670.00	0.0006979	0.0002608	0.1757E 09	0.3317E 09	0.8953	0.2115E 00	0.137762E-02	0.105700E-02	0.303327E 02

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REENTRY F TURB. DATA AT 60000 FT. ZERO DEG. RAY. ALPHA EQUALS -.72 DEG.

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1969E 02	0.3879E 03	0.1420E 04	0.4660E-01	0.1902E 09	0.5000E 01	0.1305E 02	0.1443E 02	0.6000E 05	0.1902E 05

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	RDUE/RDUINF	REELS
0.1510E 03	0.5580E 01	0.1833E 01	0.9919E 00	0.3020E 01	0.3590E 09

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	RDSTRDE	EDGE PARA	T.E.P.	P.E.
0.468	0.15	520.00	0.0005378	0.0002008	0.8902E 08	0.1680E 09	0.8913	0.2202E 00	0.102291E-02	0.117854E-02	-0.132057E 02
0.545	0.15	530.00	0.0005481	0.0002047	0.1037E 09	0.1956E 09	0.8924	0.2187E 00	0.104875E-02	0.115017E-02	-0.881790E 01
0.635	0.15	547.00	0.0005657	0.0002112	0.1208E 09	0.2279E 09	0.8935	0.2171E 00	0.108868E-02	0.112238E-02	-0.300297E 01
0.699	0.15	544.00	0.0005626	0.0002101	0.1330E 09	0.2509E 09	0.8942	0.2162E 00	0.108659E-02	0.110527E-02	-0.169000E 01
0.776	0.15	533.00	0.0005512	0.0002058	0.1476E 09	0.2785E 09	0.8949	0.2152E 00	0.106872E-02	0.108694E-02	-0.167645E 01
0.853	0.14	537.00	0.0005553	0.0002074	0.1622E 09	0.3062E 09	0.8956	0.2143E 00	0.108045E-02	0.107061E-02	0.918502E 00
0.924	0.14	520.00	0.0005378	0.0002008	0.1757E 09	0.3317E 09	0.8961	0.2136E 00	0.104925E-02	0.105700E-02	-0.733733E 00

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Table 6. Ground Facilities and Test Conditions for Turbulent Data

Source	Ref.	M_∞	$Re_\infty \times 10^{-6}/ft$	T_o, °R	θ_c, deg	L_s, ft	$Re_e \times 10^{-6}/ft$	M_e	T_w/T_o	$(C_e^*)^n$	$(\rho^*/\rho_e)^{1-2n}$
NOL	22	7.9	9.1	~1450	5.0	2.008	11.9	~7.2	0.35	0.98	0.40
			6.2				8.1		0.34	0.98	0.40
			9.3				12.1		0.32	0.98	0.40
			9.2				12.0		0.24	0.99	0.43
			9.3				12.1		0.20	0.99	0.44
			9.2				11.9		0.11	0.99	0.49
Langley	25	6.9	4.7	~1100	10	1.015	7.2	~5.6	0.52	0.99	0.46
			5.0				7.7		0.51	0.99	0.46
			5.3				8.2		0.52	0.99	0.46
			6.2				9.6		0.53	0.98	0.45
			6.2				9.6		0.45	0.98	0.47
VKF-B	27	~8.0	2.2	~1800	7.2	3.61	3.2	~6.8	0.41	0.98	0.41
VKF-C	27,29	~10	2.2	~2000	7.2	3.60	3.4	8.2	0.28	0.98	0.37
	27,29	~10	2.1	~2000	8.0	3.00	3.4	8.1	0.28	0.98	0.38
	27,29	~10	1.5	~2000	8.0	3.00	2.4	8.1	0.28	0.98	0.39
VKF-F	30,32	10.8	10.2	~2100	6.3	1.71	15.6	9.0	0.25	0.97	0.35
		10.8	8.0	~2400			12.4	8.9	0.23	0.97	0.35
		10.7	6.1	~2700			9.5	8.9	0.20	0.97	0.36
		10.6	5.0	~2800			7.8	8.8	0.19	0.97	0.37
		7.4	9.5	~2100	10	1.44	15.1	6.0	0.26	0.98	0.51
		7.9	42.0	~1500			67.4	6.2	0.35	0.98	0.46
		7.9	65.0	~1600			104.0	6.2	0.34	0.98	0.46
		7.7	42.0	~1800			67.0	6.1	0.30	0.98	0.46

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Table 7. Turbulent Ground Facility Data

TURBULENT 5.0 OEG. CONE OATA FROM NOL HYPERSONIC TUNNEL

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(OEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.7900E 01	0.1090E 03	0.5160E 03	0.3511E 00	0.1835E 08	0.5000E 01	0.2008E 01	0.7182E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.3498E 02	0.1878E 01	0.1200E 01	0.9959E 00	0.1558E 01	0.2383E 08

EXPERIMENTAL OATA

N	QOOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EOGE PARA	T.E.P.	P.E.
0.17	5.5240	0.0009925	0.0007640	0.9250E 07	0.1201E 08	0.9786	0.3956E 00	0.197352E-02	0.179753E-02	0.979060E 01
0.17	5.2059	0.0009354	0.0007200	0.1002E 08	0.1301E 08	0.9788	0.3943E 00	0.186552E-02	0.177465E-02	0.512023E 01
0.17	5.3143	0.0009548	0.0007350	0.1070E 08	0.1389E 08	0.9789	0.3933E 00	0.190908E-02	0.175613E-02	0.870929E 01
0.17	5.0613	0.0009094	0.0007000	0.1140E 08	0.1480E 08	0.9790	0.3923E 00	0.182245E-02	0.173848E-02	0.482992E 01
0.17	5.2637	0.0009457	0.0007280	0.1140E 08	0.1480E 08	0.9790	0.3923E 00	0.189535E-02	0.173848E-02	0.902312E 01
0.17	5.1336	0.0009224	0.0007100	0.1209E 08	0.1570E 08	0.9791	0.3914E 00	0.185254E-02	0.172204E-02	0.757831E 01
0.17	5.0613	0.0009094	0.0007000	0.1287E 08	0.1670E 08	0.9792	0.3905E 00	0.183058E-02	0.170510E-02	0.735916E 01
0.17	4.9890	0.0008964	0.0006900	0.1428E 08	0.1854E 08	0.9794	0.3890E 00	0.181123E-02	0.167690E-02	0.801088E 01
0.17	4.3382	0.0007795	0.0006000	0.1569E 08	0.2037E 08	0.9795	0.3876E 00	0.158029E-02	0.165177E-02	-0.432749E 01
0.17	4.4467	0.0007989	0.0006150	0.1578E 08	0.2049E 08	0.9795	0.3875E 00	0.162013E-02	0.165023E-02	-0.182395E 01

TURBULENT 5.0 DEG. CONE DATA FROM NOL HYPERSONIC TUNNEL

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.7900E 01	0.1070E 03	0.4900E 03	0.3397E 00	0.1249E 08	0.5000E 01	0.2008E 01	0.7182E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.2352E 02	0.1878E 01	0.1200E 01	0.9959E 00	0.1558E 01	0.1621E 08

EXPERIMENTAL OATA

N	QOOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.17	3.3448	0.0008864	0.0006800	0.9092E 07	0.1180E 08	0.9799	0.3992E 00	0.173838E-02	0.180249E-02	-0.355670E 01
0.17	3.5416	0.0009386	0.0007200	0.9554E 07	0.1240E 08	0.9800	0.3984E 00	0.184408E-02	0.178824E-02	0.312250E 01
0.17	3.1726	0.0008408	0.0006450	0.1055E 08	0.1370E 08	0.9802	0.3969E 00	0.165813E-02	0.176001E-02	-0.578854E 01
0.17	3.3448	0.0008864	0.0006800	0.1055E 08	0.1370E 08	0.9802	0.3969E 00	0.174811E-02	0.176001E-02	-0.676289E 00

Table 7. Continued

TURBULENT 5.0 DEG. CONE OATA FROM NOL HYPERSONIC TUNNEL

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.7900E 01	0.1066E 03	0.4630E 03	0.3222E 00	0.1867E 08	0.5000E 01	0.2008E 01	0.7182E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.3501E 02	0.1878E 01	0.1200E 01	0.9959E 00	0.1558E 01	0.2424E 08

EXPERIMENTAL OATA

N	QOOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EOGE PARA	T.E.P.	P.E.
0.17	5.6548	0.0009826	0.0007500	0.9244E 07	0.1200E 08	0.9810	0.4041E 00	0.189194E-02	0.179772E-02	0.524108E 01
0.17	5.2778	0.0009171	0.0007000	0.1001E 08	0.1299E 08	0.9811	0.4029E 00	0.177099E-02	0.177498E-02	-0.224373E 00
0.17	5.3231	0.0009250	0.0007060	0.1001E 08	0.1299E 08	0.9811	0.4029E 00	0.178617E-02	0.177498E-02	0.630828E 00
0.17	5.5040	0.0009564	0.0007300	0.1070E 08	0.1389E 08	0.9812	0.4019E 00	0.185139E-02	0.175612E-02	0.542515E 01
0.17	4.9008	0.0008516	0.0006500	0.1139E 08	0.1479E 08	0.9813	0.4009E 00	0.165223E-02	0.173863E-02	-0.496951E 01
0.17	5.1270	0.0008909	0.0006800	0.1139E 08	0.1479E 08	0.9813	0.4009E 00	0.172848E-02	0.173863E-02	-0.583486E 00
0.17	5.2024	0.0009040	0.0006900	0.1210E 08	0.1571E 08	0.9814	0.4000E 00	0.175770E-02	0.172190E-02	0.207927E 01
0.17	5.0516	0.0008778	0.0006700	0.1287E 08	0.1670E 08	0.9815	0.3991E 00	0.171047E-02	0.170508E-02	0.316335E 00
0.17	5.1647	0.0008975	0.0006850	0.1287E 08	0.1670E 08	0.9815	0.3991E 00	0.174876E-02	0.170508E-02	0.256220E 01
0.17	4.6520	0.0008084	0.0006170	0.1356E 08	0.1760E 08	0.9815	0.3983E 00	0.157806E-02	0.169087E-02	-0.667123E 01
0.17	4.5238	0.0007861	0.0006000	0.1425E 08	0.1850E 08	0.9816	0.3976E 00	0.153725E-02	0.167747E-02	-0.835921E 01
0.17	4.5992	0.0007992	0.0006100	0.1572E 08	0.2041E 08	0.9817	0.3962E 00	0.156820E-02	0.165124E-02	-0.502873E 01

TURBULENT 5.0 DEG. CONE OATA FROM NOL HYPERSONIC TUNNEL

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(OEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.7900E 01	0.1084E 03	0.3540E 03	0.2422E 00	0.1851E 08	0.5000E 01	0.2008E 01	0.7182E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.3505E 02	0.1878E 01	0.1200E 01	0.9959E 00	0.1558E 01	0.2403E 08

EXPERIMENTAL OATA

N	QOOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EOGE PARA	T.E.P.	P.E.
0.17	6.5963	0.0010156	0.0007600	0.9016E 07	0.1170E 08	0.9844	0.4309E 00	0.179180E-02	0.180490E-02	-0.725621E 00
0.17	6.1884	0.0009528	0.0007130	0.9775E 07	0.1269E 08	0.9845	0.4297E 00	0.168552E-02	0.178170E-02	-0.539831E 01
0.17	6.1189	0.0009421	0.0007050	0.1048E 08	0.1360E 08	0.9846	0.4287E 00	0.167043E-02	0.176200E-02	-0.519725E 01
0.17	6.2057	0.0009555	0.0007150	0.1118E 08	0.1452E 08	0.9847	0.4277E 00	0.169772E-02	0.174378E-02	-0.264149E 01
0.17	5.9453	0.0009154	0.0006850	0.1118E 08	0.1452E 08	0.9847	0.4277E 00	0.162648E-02	0.174378E-02	-0.672647E 01
0.17	6.1016	0.0009394	0.0007030	0.1255E 08	0.1630E 08	0.9848	0.4261E 00	0.167545E-02	0.171183E-02	-0.212543E 01
0.17	5.7284	0.0008820	0.0006600	0.1255E 08	0.1630E 08	0.9848	0.4261E 00	0.157296E-02	0.171183E-02	-0.811207E 01
0.16	5.7718	0.0008887	0.0006650	0.1394E 08	0.1810E 08	0.9849	0.4246E 00	0.159016E-02	0.168333E-02	-0.553513E 01

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Table 7. Continued

TURBULENT 5.0 DEG. CONE DATA FROM NOL HYPERSONIC TUNNEL

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.7900E 01	0.1068E 03	0.2840E 03	0.1972E 00	0.1867E 08	0.5000E 01	0.2008E 01	0.7182E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.3501E 02	0.1878E 01	0.1200E 01	0.9959E 00	0.1558E 01	0.2424E 08

EXPERIMENTAL DATA

N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.17	6.2934	0.0009226	0.0006840	0.1033E 08	0.1341E 08	0.9872	0.4463E 00	0.155234E-02	0.176613E-02	-0.121050E 02
0.16	6.2474	0.0009158	0.0006790	0.1171E 08	0.1520E 08	0.9874	0.4446E 00	0.154691E-02	0.173100E-02	-0.106348E 02
0.16	6.2934	0.0009226	0.0006840	0.1247E 08	0.1619E 08	0.9874	0.4437E 00	0.156127E-02	0.171354E-02	-0.888637E 01
0.16	6.0082	0.0008807	0.0006530	0.1326E 08	0.1721E 08	0.9875	0.4428E 00	0.149323E-02	0.169691E-02	-0.120032E 02
0.16	5.9806	0.0008767	0.0006500	0.1464E 08	0.1901E 08	0.9876	0.4415E 00	0.149072E-02	0.167020E-02	-0.107463E 02
0.16	5.5757	0.0008174	0.0006060	0.1572E 08	0.2041E 08	0.9876	0.4406E 00	0.139270E-02	0.165124E-02	-0.156573E 02
0.16	5.7045	0.0008362	0.0006200	0.1572E 08	0.2041E 08	0.9876	0.4406E 00	0.142487E-02	0.165124E-02	-0.137088E 02

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TURBULENT 5.0 DEG. CONE DATA FROM NOL HYPERSONIC TUNNEL

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.7900E 01	0.1084E 03	0.1580E 03	0.1081E 00	0.1845E 08	0.5000E 01	0.2008E 01	0.7182E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.3501E 02	0.1878E 01	0.1200E 01	0.9959E 00	0.1558E 01	0.2396E 08

EXPERIMENTAL DATA

N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.16	6.6411	0.0008698	0.0006350	0.9006E 07	0.1169E 08	0.9910	0.4897E 00	0.130865E-02	0.180524E-02	-0.275081E 02
0.16	6.1705	0.0008081	0.0005900	0.1048E 08	0.1361E 08	0.9911	0.4876E 00	0.122081E-02	0.176192E-02	-0.307114E 02
0.16	6.2751	0.0008218	0.0006000	0.1116E 08	0.1449E 08	0.9911	0.4868E 00	0.124355E-02	0.174422E-02	-0.287049E 02
0.16	6.3797	0.0008355	0.0006100	0.1116E 08	0.1449E 08	0.9911	0.4868E 00	0.126427E-02	0.174422E-02	-0.275166E 02
0.16	6.3797	0.0008355	0.0006100	0.1187E 08	0.1540E 08	0.9911	0.4860E 00	0.126626E-02	0.172730E-02	-0.266912E 02
0.16	6.1705	0.0008081	0.0005900	0.1255E 08	0.1629E 08	0.9912	0.4853E 00	0.122651E-02	0.171191E-02	-0.283547E 02
0.16	6.2751	0.0008218	0.0006000	0.1395E 08	0.1811E 08	0.9913	0.4840E 00	0.125065E-02	0.168314E-02	-0.256954E 02
0.16	5.9613	0.0007807	0.0005700	0.1541E 08	0.2000E 08	0.9913	0.4828E 00	0.119107E-02	0.165658E-02	-0.281009E 02
0.16	6.1182	0.0008013	0.0005850	0.1541E 08	0.2000E 08	0.9913	0.4828E 00	0.122241E-02	0.165658E-02	-0.262089E 02

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Table 7. Continued

TURBULENT 10 DEG CONE OATA FROM NASA LANGLEY 11 INCH HYPERSONIC TUNNEL

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(OEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.6860E 01	0.1028E 03	0.5564E 03	0.5198E 00	0.4771E 07	0.1000E 02	0.1015E 01	0.5612E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.1909E 02	0.3298E 01	0.1453E 01	0.9862E 00	0.2238E 01	0.7345E 07

EXPERIMENTAL OATA

X/L	N	QOOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.893	0.18	2.6203	0.0017900	0.0010317	0.4260E 07	0.6559E 07	0.9815	0.4586E 00	0.229225E-02	0.198014E-02	0.157623E 02
0.913	0.18	2.6203	0.0017900	0.0010317	0.4355E 07	0.6706E 07	0.9815	0.4582E 00	0.229394E-02	0.197313E-02	0.162588E 02
0.934	0.18	2.6203	0.0017900	0.0010317	0.4456E 07	0.6860E 07	0.9816	0.4579E 00	0.229567E-02	0.196597E-02	0.167704E 02
0.954	0.17	2.6203	0.0017900	0.0010317	0.4551E 07	0.7007E 07	0.9816	0.4575E 00	0.229727E-02	0.195931E-02	0.172490E 02

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TURBULENT 10 OEG CONE OATA FROM NASA LANGLEY 11 INCH HYPERSONIC TUNNEL

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(OEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.6860E 01	0.1032E 03	0.5483E 03	0.5103E 00	0.5085E 07	0.1000E 02	0.1015E 01	0.5612E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.2055E 02	0.3298E 01	0.1453E 01	0.9862E 00	0.2238E 01	0.7829E 07

EXPERIMENTAL OATA

X/L	N	QOOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EOGE PARA	T.E.P.	P.E.
0.893	0.17	3.0595	0.0019000	0.0010889	0.4541E 07	0.6992E 07	0.9818	0.4601E 00	0.241083E-02	0.196000E-02	0.230012E 02
0.913	0.17	2.8824	0.0017900	0.0010259	0.4643E 07	0.7148E 07	0.9819	0.4597E 00	0.227289E-02	0.195307E-02	0.163755E 02
0.934	0.17	2.8019	0.0017400	0.0009972	0.4750E 07	0.7313E 07	0.9819	0.4593E 00	0.221104E-02	0.194598E-02	0.136210E 02
0.954	0.17	2.8019	0.0017400	0.0009972	0.4851E 07	0.7469E 07	0.9819	0.4590E 00	0.221256E-02	0.193939E-02	0.140851E 02

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Table 7. Continued

TURBULENT 10 DEG CONE DATA FROM NASA LANGLEY 11 INCH HYPERSONIC TUNNEL

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.6860E 01	0.1027E 03	0.5564E 03	0.5203E 00	0.5410E 07	0.1000E 02	0.1015E 01	0.5612E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.2166E 02	0.3298E 01	0.1453E 01	0.9862E 00	0.2238E 01	0.8330E 07

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.893	0.17	2.9021	0.0017500	0.0010090	0.4831E 07	0.7438E 07	0.9817	0.4564E 00	0.225163E-02	0.194068E-02	0.160228E 02
0.913	0.17	2.7695	0.0016700	0.0009628	0.4939E 07	0.7605E 07	0.9817	0.4561E 00	0.215025E-02	0.193381E-02	0.111925E 02
0.934	0.17	2.7695	0.0016700	0.0009628	0.5053E 07	0.7780E 07	0.9818	0.4558E 00	0.215185E-02	0.192679E-02	0.116804E 02
0.954	0.17	2.7695	0.0016700	0.0009628	0.5161E 07	0.7946E 07	0.9818	0.4554E 00	0.215333E-02	0.192027E-02	0.121366E 02

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TURBULENT 10 DEG CONE DATA FROM NASA LANGLEY 11 INCH HYPERSONIC TUNNEL

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.6860E 01	0.1002E 03	0.5528E 03	0.5299E 00	0.6303E 07	0.1000E 02	0.1015E 01	0.5612E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.2412E 02	0.3298E 01	0.1453E 01	0.9862E 00	0.2238E 01	0.9705E 07

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.872	0.17	3.5221	0.0019700	0.0011425	0.5496E 07	0.8462E 07	0.9824	0.4521E 00	0.257257E-02	0.190104E-02	0.353245E 02
0.893	0.17	3.5221	0.0019700	0.0011425	0.5629E 07	0.8666E 07	0.9825	0.4517E 00	0.257456E-02	0.189382E-02	0.359456E 02
0.913	0.17	3.3969	0.0019000	0.0011019	0.5755E 07	0.8860E 07	0.9825	0.4514E 00	0.248486E-02	0.188712E-02	0.316747E 02
0.934	0.17	3.3075	0.0018500	0.0010729	0.5887E 07	0.9064E 07	0.9825	0.4510E 00	0.242124E-02	0.188026E-02	0.287711E 02
0.954	0.17	3.2539	0.0018200	0.0010555	0.6013E 07	0.9258E 07	0.9825	0.4507E 00	0.238360E-02	0.187390E-02	0.271998E 02

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Table 7. Continued

TURBULENT 10 DEG CONE DATA FROM NASA LANGLEY 11 INCH HYPERSONIC TUNNEL

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.6860E 01	0.1201E 03	0.5625E 03	0.4498E 00	0.6303E 07	0.1000E 02	0.1015E 01	0.5612E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.2392E 02	0.3298E 01	0.1453E 01	0.9862E 00	0.2238E 01	0.9705E 07

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.913	0.17	4.8612	0.0021400	0.0011896	0.5755E 07	0.8860E 07	0.9790	0.4730E 00	0.256897E-02	0.188711E-02	0.361327E 02
0.934	0.17	4.7249	0.0020800	0.0011562	0.5887E 07	0.9064E 07	0.9791	0.4726E 00	0.249859E-02	0.188026E-02	0.328855E 02
0.954	0.17	4.7476	0.0020900	0.0011618	0.6013E 07	0.9258E 07	0.9791	0.4723E 00	0.251214E-02	0.187390E-02	0.340595E 02

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TURBULENT SHARP CONE DATA FROM VKF 50 IN. HYPERSONIC TUNNEL B

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.7970E 01	0.9550E 02	0.5338E 03	0.4079E 00	0.7844E 07	0.7170E 01	0.3608E 01	0.6837E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.7176E 01	0.2668E 01	0.1344E 01	0.9947E 00	0.1974E 01	0.1151E 08

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.641	0.18	1.2760	0.0012758	0.0007904	0.5028E 07	0.7381E 07	0.9793	0.4078E 00	0.197940E-02	0.194308E-02	0.186888E 01
0.687	0.18	1.2230	0.0012228	0.0007576	0.5389E 07	0.7911E 07	0.9794	0.4066E 00	0.190248E-02	0.192166E-02	-0.998152E 00
0.769	0.18	1.0910	0.0010908	0.0006758	0.6032E 07	0.8855E 07	0.9796	0.4047E 00	0.170475E-02	0.188730E-02	-0.967250E 01
0.816	0.18	1.1460	0.0011458	0.0007099	0.6401E 07	0.9396E 07	0.9797	0.4037E 00	0.179486E-02	0.186947E-02	-0.399113E 01
0.862	0.18	1.0860	0.0010859	0.0006727	0.6762E 07	0.9926E 07	0.9798	0.4028E 00	0.170451E-02	0.185314E-02	-0.802016E 01

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Table 7. Continued

TURBULENT SHARP CONE DATA FROM VKF 50 IN. HYPERSONIC TUNNEL B

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.7970E 01	0.9550E 02	0.5319E 03	0.4064E 00	0.7844E 07	0.7170E 01	0.3608E 01	0.6837E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.7176E 01	0.2668E 01	0.1344E 01	0.9947E 00	0.1974E 01	0.1151E 08

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.687	0.18	1.4800	0.0014762	0.0009141	0.5389E 07	0.7911E 07	0.9795	0.4070E 00	0.229307E-02	0.192166E-02	0.193280E 02
0.769	0.18	1.3450	0.0013415	0.0008307	0.6032E 07	0.8855E 07	0.9797	0.4051E 00	0.209324E-02	0.188730E-02	0.109120E 02
0.816	0.18	1.2140	0.0012109	0.0007498	0.6401E 07	0.9396E 07	0.9798	0.4041E 00	0.189375E-02	0.186947E-02	0.129883E 01
0.862	0.18	1.2510	0.0012478	0.0007726	0.6762E 07	0.9926E 07	0.9799	0.4032E 00	0.195563E-02	0.185314E-02	0.553050E 01
0.909	0.17	1.2740	0.0012707	0.0007869	0.7130E 07	0.1047E 08	0.9799	0.4024E 00	0.199566E-02	0.183747E-02	0.860911E 01
0.955	0.17	1.1680	0.0011650	0.0007214	0.7491E 07	0.1100E 08	0.9800	0.4016E 00	0.183307E-02	0.182301E-02	0.551843E 00

TURBULENT SHARP CONE DATA FROM VKF 50 IN. HYPERSONIC TUNNEL B

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.7970E 01	0.9550E 02	0.5373E 03	0.4105E 00	0.7844E 07	0.7170E 01	0.3608E 01	0.6837E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.7176F 01	0.2668E 01	0.1344E 01	0.9947E 00	0.1974E 01	0.1151E 08

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.641	0.18	1.3500	0.0013559	0.0008409	0.5028E 07	0.7381E 07	0.9792	0.4071E 00	0.210970E-02	0.194308E-02	0.857462E 01
0.687	0.18	1.3610	0.0013670	0.0008478	0.5389E 07	0.7911E 07	0.9793	0.4059E 00	0.213284E-02	0.192166E-02	0.109895E 02
0.769	0.18	1.1410	0.0011460	0.0007107	0.6032E 07	0.8855E 07	0.9795	0.4040E 00	0.179611E-02	0.188730E-02	-0.483144E 01
0.816	0.18	1.1720	0.0011772	0.0007301	0.6401E 07	0.9396E 07	0.9796	0.4030E 00	0.184922E-02	0.186947E-02	-0.108334E 01
0.862	0.18	1.1710	0.0011762	0.0007294	0.6762E 07	0.9926E 07	0.9797	0.4021E 00	0.185159E-02	0.185314E-02	-0.834509E-01
0.909	0.17	1.0960	0.0011008	0.0006827	0.7130E 07	0.1047E 08	0.9798	0.4013E 00	0.173656E-02	0.183747E-02	-0.549139E 01
0.955	0.17	1.0040	0.0010084	0.0006254	0.7491E 07	0.1100E 08	0.9798	0.4005E 00	0.159381E-02	0.182301E-02	-0.125724E 02

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Table 7. Continued

TURBULENT SHARP CONE DATA FROM VKF 50 IN. HYPERSONIC TUNNEL C

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1013E 02	0.9410E 02	0.5593E 03	0.2761E 00	0.7822E 07	0.7170E 01	0.3603E 01	0.8243E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.5511E 01	0.3582E 01	0.1502E 01	0.9973E 00	0.2378E 01	0.1238E 08

EXPERIMENTAL OATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTRDE	EDGE PARA	T.E.P.	P.E.
0.641	0.18	2.5130	0.0013507	0.0006675	0.5014E 07	0.7937E 07	0.9682	0.3736E 00	0.184540E-02	0.192062E-02	-0.391658E 01
0.687	0.18	2.4710	0.0013281	0.0006563	0.5374E 07	0.8507E 07	0.9684	0.3723E 00	0.182020E-02	0.189944E-02	-0.417174E 01
0.769	0.18	2.1660	0.0011642	0.0005753	0.6015E 07	0.9522E 07	0.9687	0.3704E 00	0.160351E-02	0.186548E-02	-0.140432E 02
0.816	0.18	2.1990	0.0011819	0.0005841	0.6383E 07	0.1010E 08	0.9689	0.3694E 00	0.163216E-02	0.184786E-02	-0.116727E 02
0.862	0.18	2.1500	0.0011556	0.0005711	0.6743E 07	0.1067E 08	0.9690	0.3684E 00	0.159959E-02	0.183172E-02	-0.126726E 02

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TURBULENT SHARP CONE DATA FROM VKF 50 IN. HYPERSONIC TUNNEL C

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1013E 02	0.9410E 02	0.5705E 03	0.2817E 00	0.7822E 07	0.7170E 01	0.3603E 01	0.8243E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.5511E 01	0.3582E 01	0.1502E 01	0.9973E 00	0.2378E 01	0.1238E 08

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.687	0.18	2.7360	0.0014819	0.0007333	0.5374E 07	0.8507E 07	0.9680	0.3708E 00	0.204303E-02	0.189944E-02	0.755977E 01
0.769	0.18	2.4550	0.0013297	0.0006580	0.6015E 07	0.9522E 07	0.9683	0.3688E 00	0.184243E-02	0.186548E-02	-0.123565E 01
0.816	0.18	2.2790	0.0012343	0.0006108	0.6383E 07	0.1010E 08	0.9685	0.3678E 00	0.171481E-02	0.184786E-02	-0.719996E 01
0.862	0.18	2.3490	0.0012723	0.0006296	0.6743E 07	0.1067E 08	0.9686	0.3669E 00	0.177172E-02	0.183172E-02	-0.327568E 01
0.909	0.18	2.4420	0.0013226	0.0006545	0.7110E 07	0.1126E 08	0.9688	0.3660E 00	0.184609E-02	0.181622E-02	0.164469E 01
0.955	0.18	2.2390	0.0012127	0.0006001	0.7470E 07	0.1183E 08	0.9689	0.3651E 00	0.169622E-02	0.180194E-02	-0.586666E 01

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Table 7. Continued

TURBULENT SHARP CONE DATA FROM VKF 50 IN. HYPERSONIC TUNNEL C

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1013E 02	0.9410E 02	0.5636E 03	0.2783E 00	0.7822E 07	0.7170E 01	0.3603E 01	0.8243E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.5511E 01	0.3582E 01	0.1502E 01	0.9973E 00	0.2378E 01	0.1238E 08

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.641	0.18	2.9090	0.0015681	0.0007753	0.5014E 07	0.7937E 07	0.9681	0.3730E 00	0.214737E-02	0.192062E-02	0.118058E 02
0.687	0.18	2.8620	0.0015428	0.0007628	0.5374E 07	0.8507E 07	0.9683	0.3717E 00	0.211926E-02	0.189944E-02	0.115729E 02
0.769	0.18	2.3900	0.0012883	0.0006370	0.6015E 07	0.9522E 07	0.9686	0.3698E 00	0.177862E-02	0.186548E-02	-0.465611E 01
0.816	0.18	2.4840	0.0013390	0.0006621	0.6383E 07	0.1010E 08	0.9687	0.3687E 00	0.185339E-02	0.184786E-02	0.299238E 00
0.862	0.18	2.4260	0.0013078	0.0006466	0.6743E 07	0.1067E 08	0.9689	0.3678E 00	0.181443E-02	0.183172E-02	-0.943873E 00
0.909	0.18	2.2070	0.0011897	0.0005882	0.7110E 07	0.1126E 08	0.9690	0.3669E 00	0.165442E-02	0.181622E-02	-0.890897E 01
0.955	0.18	2.2130	0.0011929	0.0005898	0.7470E 07	0.1183E 08	0.9691	0.3661E 00	0.166242E-02	0.180194E-02	-0.774262E 01

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TURBULENT SHARP CONE DATA FROM VKF 50 IN. HYPERSONIC TUNNEL C

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1025E 02	0.8620E 02	0.5320E 03	0.2804E 00	0.6300E 07	0.8000E 01	0.3000E 01	0.8050E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.4970E 01	0.4226E 01	0.1610E 01	0.9965E 00	0.2615E 01	0.1023E 08

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.730	0.18	2.8913	0.0017500	0.0007872	0.4599E 07	0.7470E 07	0.9708	0.3822E 00	0.212134E-02	0.193935E-02	0.938410E 01
0.730	0.18	3.2218	0.0019500	0.0008771	0.4599E 07	0.7470E 07	0.9708	0.3822E 00	0.236378E-02	0.193935E-02	0.218851E 02
0.790	0.18	2.8913	0.0017500	0.0007872	0.4977E 07	0.8084E 07	0.9710	0.3808E 00	0.212872E-02	0.191499E-02	0.111604E 02
0.790	0.18	3.2218	0.0019500	0.0008771	0.4977E 07	0.8084E 07	0.9710	0.3808E 00	0.237200E-02	0.191499E-02	0.238645E 02
0.890	0.18	2.8913	0.0017500	0.0007872	0.5607E 07	0.9108E 07	0.9713	0.3788E 00	0.213973E-02	0.187882E-02	0.138868E 02
0.890	0.18	3.2218	0.0019500	0.0008771	0.5607E 07	0.9108E 07	0.9713	0.3788E 00	0.238427E-02	0.187882E-02	0.269024E 02
0.950	0.18	2.7261	0.0016500	0.0007422	0.5985E 07	0.9722E 07	0.9714	0.3777E 00	0.202309E-02	0.185931E-02	0.880861E 01
0.950	0.18	3.0565	0.0018500	0.0008321	0.5985E 07	0.9722E 07	0.9714	0.3777E 00	0.226832E-02	0.185931E-02	0.219975E 02

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Table 7. Continued

TURBULENT SHARP CONE DATA FROM VKF 50 IN. HYPERSONIC TUNNEL C

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1022E 02	0.8680E 02	0.5320E 03	0.2800E 00	0.4500E 07	0.8000E 01	0.3000E 01	0.8033E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.3742E 01	0.4208E 01	0.1607E 01	0.9965E 00	0.2609E 01	0.7306E 07

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.890	0.18	2.1052	0.0017000	0.0007664	0.4005E 07	0.6502E 07	0.9704	0.3856E 00	0.204840E-02	0.198291E-02	0.330238E 01
0.890	0.18	2.4767	0.0020000	0.0009017	0.4005E 07	0.6502E 07	0.9704	0.3856E 00	0.240988E-02	0.198291E-02	0.215322E 02
0.950	0.18	2.2290	0.0018000	0.0008115	0.4275E 07	0.6940E 07	0.9706	0.3844E 00	0.217523E-02	0.196232E-02	0.108496E 02
0.950	0.18	2.3528	0.0019000	0.0008566	0.4275E 07	0.6940E 07	0.9706	0.3844E 00	0.229607E-02	0.196232E-02	0.170079E 02

TURBULENT SHARP CONE DATA FROM VKF 108 IN. HYPERVELOCITY TUNNEL F

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1081E 02	0.8890E 02	0.5400E 03	0.2492E 00	0.1733E 08	0.6300E 01	0.1707E 01	0.8946E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.2233E 02	0.3299E 01	0.1454E 01	0.9979E 00	0.2264E 01	0.2698E 08

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.380	0.18	8.8000	0.0009583	0.0004943	0.6586E 07	0.1025E 08	0.9676	0.3485E 00	0.146556E-02	0.184352E-02	-0.205023E 02
0.380	0.18	9.3000	0.0010127	0.0005223	0.6586E 07	0.1025E 08	0.9676	0.3485E 00	0.154883E-02	0.184352E-02	-0.159854E 02
0.480	0.18	8.7000	0.0009474	0.0004886	0.8319E 07	0.1295E 08	0.9682	0.3445E 00	0.146493E-02	0.177589E-02	-0.175102E 02
0.480	0.18	9.1000	0.0009909	0.0005111	0.8319E 07	0.1295E 08	0.9682	0.3445E 00	0.153228E-02	0.177589E-02	-0.137176E 02
0.579	0.18	10.2000	0.0011107	0.0005729	0.1003E 08	0.1562E 08	0.9687	0.3414E 00	0.173226E-02	0.172340E-02	0.514406E 00
0.668	0.17	9.7000	0.0010563	0.0005448	0.1158E 08	0.1803E 08	0.9691	0.3391E 00	0.165788E-02	0.168442E-02	-0.157549E 01
0.668	0.17	9.8000	0.0010672	0.0005504	0.1158E 08	0.1803E 08	0.9691	0.3391E 00	0.167497E-02	0.168442E-02	-0.560811E 00
0.730	0.17	8.1000	0.0008821	0.0004549	0.1265E 08	0.1970E 08	0.9693	0.3377E 00	0.138981E-02	0.166067E-02	-0.163101E 02
0.792	0.17	8.3000	0.0009038	0.0004662	0.1373E 08	0.2137E 08	0.9695	0.3365E 00	0.142916E-02	0.163915E-02	-0.128108E 02
0.792	0.17	8.5000	0.0009256	0.0004774	0.1373E 08	0.2137E 08	0.9695	0.3365E 00	0.146360E-02	0.163915E-02	-0.107098E 02

Table 7. Continued

TURBULENT SHARP CONE DATA FROM VKF 108 IN. HYPERVELOCITY TUNNEL F

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1076E 02	0.9860E 02	0.5400E 03	0.2267E 00	0.1359E 08	0.6300E 01	0.1707E 01	0.8914E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.2055E 02	0.3280E 01	0.1451E 01	0.9979E 00	0.2256E 01	0.2113E 08

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.668	0.18	11.0000	0.0012163	0.0006266	0.9077E 07	0.1411E 08	0.9658	0.3503E 00	0.185210E-02	0.175166E-02	0.573370E 01
0.668	0.18	11.8000	0.0013047	0.0006721	0.9077E 07	0.1411E 08	0.9658	0.3503E 00	0.198680E-02	0.175166E-02	0.134234E 02
0.730	0.17	9.3000	0.0010283	0.0005297	0.9919E 07	0.1542E 08	0.9660	0.3488E 00	0.157191E-02	0.172696E-02	-0.897838E 01
0.792	0.17	8.7000	0.0009620	0.0004955	0.1076E 08	0.1673E 08	0.9662	0.3476E 00	0.147564E-02	0.170458E-02	-0.134309E 02
0.792	0.17	10.2000	0.0011278	0.0005810	0.1076E 08	0.1673E 08	0.9662	0.3476E 00	0.173007E-02	0.170458E-02	0.149485E 01

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TURBULENT SHARP CONE DATA FROM VKF 108 IN. HYPERVELOCITY TUNNEL F

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1065E 02	0.1121E 03	0.5400E 03	0.2034E 00	0.1043E 08	0.6300E 01	0.1707E 01	0.8845E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.1931E 02	0.3238E 01	0.1444E 01	0.9979E 00	0.2238E 01	0.1617E 08

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.668	0.18	13.2000	0.0014571	0.0007531	0.6967E 07	0.1080E 08	0.9617	0.3640E 00	0.215108E-02	0.182827E-02	0.176571E 02
0.730	0.18	10.8000	0.0011921	0.0006161	0.7614E 07	0.1180E 08	0.9619	0.3626E 00	0.176665E-02	0.180249E-02	-0.198851E 01
0.730	0.18	13.8000	0.0015233	0.0007873	0.7614E 07	0.1180E 08	0.9619	0.3626E 00	0.225738E-02	0.180249E-02	0.252369E 02
0.792	0.17	8.7000	0.0009603	0.0004963	0.8261E 07	0.1281E 08	0.9622	0.3612E 00	0.142802E-02	0.177913E-02	-0.197348E 02
0.792	0.17	11.9000	0.0013136	0.0006789	0.8261E 07	0.1281E 08	0.9622	0.3612E 00	0.195327E-02	0.177913E-02	0.978809E 01

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Table 7. Continued

TURBULENT SHARP CONE DATA FROM VKF 108 IN. HYPERVELOCITY TUNNEL F

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.1057E 02	0.1198E 03	0.5400E 03	0.1931E 00	0.8569E 07	0.6300E 01	0.1707E 01	0.8794E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.1768E 02	0.3207E 01	0.1438E 01	0.9979E 00	0.2225E 01	0.1325E 08

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.667	0.18	11.4000	0.0013417	0.0006961	0.5716E 07	0.8840E 07	0.9593	0.3725E 00	0.194789E-02	0.188780E-02	0.318294E 01
0.730	0.18	9.9000	0.0011651	0.0006045	0.6255E 07	0.9675E 07	0.9596	0.3710E 00	0.169809E-02	0.186074E-02	-0.874102E 01
0.730	0.18	12.8000	0.0015065	0.0007816	0.6255E 07	0.9675E 07	0.9596	0.3710E 00	0.219551E-02	0.186074E-02	0.179914E 02
0.792	0.18	8.3000	0.0009768	0.0005068	0.6787E 07	0.1050E 08	0.9599	0.3696E 00	0.142853E-02	0.183663E-02	-0.222197E 02
0.792	0.18	10.3000	0.0012122	0.0006290	0.6787E 07	0.1050E 08	0.9599	0.3696E 00	0.177276E-02	0.183663E-02	-0.347745E 01

TURBULENT SHARP CONE DATA FROM VKF 108 IN. HYPERVELOCITY TUNNEL F

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.7410E 01	0.1730E 03	0.5400E 03	0.2605E 00	0.1360E 08	0.1000E 02	0.1438E 01	0.5951E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.8350E 02	0.3651E 01	0.1514E 01	0.9880E 00	0.2383E 01	0.2172E 08

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.529	0.16	24.5000	0.0015408	0.0007569	0.7194E 07	0.1149E 08	0.9711	0.5085E 00	0.153272E-02	0.181028E-02	-0.153324E 02
0.647	0.16	24.3000	0.0015282	0.0007507	0.8799E 07	0.1405E 08	0.9715	0.5060E 00	0.152706E-02	0.175289E-02	-0.128829E 02
0.765	0.16	23.4000	0.0014716	0.0007229	0.1040E 08	0.1661E 08	0.9719	0.5040E 00	0.147588E-02	0.170653E-02	-0.135156E 02
0.882	0.16	21.5000	0.0013521	0.0006642	0.1200E 08	0.1916E 08	0.9721	0.5023E 00	0.136016E-02	0.166811E-02	-0.184609E 02

Table 7. Continued

TURBULENT SHARP CONE OATA FROM VKF 108 IN. HYPERVELOCITY TUNNEL F

MINF	TINF(R)	TW(R)	TW/TO	REINFL5	THETA(OEG)	L5(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.7870E 01	0.1150E 03	0.5400E 03	0.3508E 00	0.6040E 08	0.1000E 02	0.1438E 01	0.6220E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REEL5
0.1872E 03	0.3966E 01	0.1567E 01	0.9892E 00	0.2504E 01	0.9711E 08

EXPERIMENTAL OATA

X/L	N	QOOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EOGE PARA	T.E.P.	P.E.
0.118	0.17	45.3000	0.0014959	0.0007164	0.7127E 07	0.1146E 08	0.9771	0.4558E 00	0.160830E-02	0.181105E-02	-0.111950E 02
0.162	0.16	41.1000	0.0013572	0.0006499	0.9785E 07	0.1573E 08	0.9777	0.4515E 00	0.147251E-02	0.172151E-02	-0.144641E 02
0.191	0.16	41.7000	0.0013771	0.0006594	0.1154E 08	0.1855E 08	0.9780	0.4493E 00	0.150083E-02	0.167674E-02	-0.104911E 02
0.235	0.16	36.6000	0.0012086	0.0005788	0.1419E 08	0.2282E 08	0.9783	0.4466E 00	0.132467E-02	0.162204E-02	-0.183331E 02
0.265	0.16	36.4000	0.0012020	0.0005756	0.1601E 08	0.2573E 08	0.9785	0.4451E 00	0.132161E-02	0.159115E-02	-0.169402E 02
0.338	0.15	34.3000	0.0011327	0.0005424	0.2042E 08	0.3282E 08	0.9789	0.4422E 00	0.125318E-02	0.153040E-02	-0.181144E 02
0.426	0.15	35.8000	0.0011822	0.0005661	0.2573E 08	0.4137E 08	0.9792	0.4395E 00	0.131553E-02	0.147477E-02	-0.107977E 02
0.529	0.15	34.5000	0.0011393	0.0005456	0.3195E 08	0.5137E 08	0.9796	0.4370E 00	0.127441E-02	0.142455E-02	-0.105398E 02
0.647	0.15	34.2000	0.0011294	0.0005408	0.3908E 08	0.6283E 08	0.9798	0.4348E 00	0.126930E-02	0.137939E-02	-0.798065E 01
0.765	0.15	33.8000	0.0011162	0.0005345	0.4621E 08	0.7429E 08	0.9801	0.4331E 00	0.125928E-02	0.134290E-02	-0.622732E 01
0.882	0.14	33.7000	0.0011129	0.0005329	0.5327E 08	0.8565E 08	0.9803	0.4316E 00	0.125956E-02	0.131267E-02	-0.404577E 01

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TURBULENT SHARP CONE OATA FROM VKF 108 IN. HYPERVELOCITY TUNNEL F

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(OEG)	L5(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.7900E 01	0.1183E 03	0.5400E 03	0.3386E 00	0.9340E 08	0.1000E 02	0.1438E 01	0.6237E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REEL5
0.3023E 03	0.3987E 01	0.1570E 01	0.9893E 00	0.2512E 01	0.1502E 09

EXPERIMENTAL DATA

X/L	N	QOOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EOGE PARA	T.E.P.	P.E.
0.088	0.16	80.0000	0.0015662	0.0007449	0.8219E 07	0.1322E 08	0.9765	0.4566E 00	0.167072E-02	0.177014E-02	-0.561650E 01
0.118	0.16	71.5000	0.0013998	0.0006658	0.1102E 08	0.1772E 08	0.9770	0.4527E 00	0.150539E-02	0.168898E-02	-0.108697E 02
0.162	0.16	65.5000	0.0012823	0.0006099	0.1513E 08	0.2433E 08	0.9776	0.4486E 00	0.139071E-02	0.160547E-02	-0.133769E 02
0.191	0.16	69.5000	0.0013606	0.0006472	0.1784E 08	0.2869E 08	0.9779	0.4466E 00	0.148188E-02	0.156372E-02	-0.523356E 01
0.235	0.15	61.8000	0.0012099	0.0005755	0.2195E 08	0.3530E 08	0.9782	0.4441E 00	0.132455E-02	0.151270E-02	-0.124381E 02
0.265	0.15	62.7000	0.0012275	0.0005838	0.2475E 08	0.3980E 08	0.9784	0.4428E 00	0.134779E-02	0.148390E-02	-0.917253E 01
0.338	0.15	61.3000	0.0012001	0.0005708	0.3157E 08	0.5077E 08	0.9788	0.4400E 00	0.132537E-02	0.142725E-02	-0.713817E 01
0.426	0.15	60.5000	0.0011844	0.0005634	0.3979E 08	0.6398E 08	0.9791	0.4375E 00	0.131508E-02	0.137537E-02	-0.438367E 01
0.529	0.14	58.7000	0.0011492	0.0005466	0.4941E 08	0.7945E 08	0.9794	0.4353E 00	0.128216E-02	0.132853E-02	-0.349055E 01
0.647	0.14	56.0000	0.0010963	0.0005215	0.6043E 08	0.9718E 08	0.9797	0.4332E 00	0.122856E-02	0.128641E-02	-0.449691E 01
0.765	0.14	57.6000	0.0011277	0.0005364	0.7145E 08	0.1149E 09	0.9799	0.4316E 00	0.126818E-02	0.125239E-02	0.126061E 01
0.882	0.14	54.1000	0.0010591	0.0005038	0.8238E 08	0.1325E 09	0.9801	0.4302E 00	0.119466E-02	0.122419E-02	-0.241263E 01

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Table 7. Concluded

TURBULENT SHARP CONE DATA FROM VKF 108 IN. HYPERVELOCITY TUNNEL F

MINF	TINF(R)	TW(R)	TW/TO	REINFLS	THETA(DEG)	LS(FT)	ME	ALT(FT)	UINF(FT/SEC)
0.7660E 01	0.1403E 03	0.5400E 03	0.3022E 00	0.6040E 08	0.1000E 02	0.1438E 01	0.6099E 01	0.1000E 01	0.1000E 01

PINF(PSF)	PE/PINF	TE/TINF	UE/UINF	ROUE/ROUINF	REELS
0.2635E 03	0.3820E 01	0.1542E 01	0.9887E 00	0.2449E 01	0.9645E 08

EXPERIMENTAL DATA

X/L	N	QDOT	STINF	STEAW	REINFL	REEL	CSTAREN	ROSTROE	EDGE PARA	T.E.P.	P.E.
0.088	0.17	83.2000	0.0017759	0.0008577	0.5315E 07	0.8488E 07	0.9730	0.4851E 00	0.181696E-02	0.190012E-02	-0.437649E 01
0.118	0.16	72.9000	0.0015561	0.0007515	0.7127E 07	0.1138E 08	0.9736	0.4811E 00	0.160443E-02	0.181300E-02	-0.115041E 02
0.162	0.16	67.9000	0.0014493	0.0007000	0.9785E 07	0.1563E 08	0.9742	0.4769E 00	0.150643E-02	0.172337E-02	-0.125877E 02
0.191	0.16	70.2000	0.0014984	0.0007237	0.1154E 08	0.1842E 08	0.9745	0.4749E 00	0.156375E-02	0.167855E-02	-0.683892E 01
0.235	0.16	62.1000	0.0013255	0.0006402	0.1419E 08	0.2267E 08	0.9749	0.4723E 00	0.139018E-02	0.162378E-02	-0.143866E 02
0.265	0.15	62.5000	0.0013341	0.0006443	0.1601E 08	0.2556E 08	0.9752	0.4709E 00	0.140306E-02	0.159287E-02	-0.119163E 02
0.338	0.15	60.5000	0.0012914	0.0006237	0.2042E 08	0.3260E 08	0.9756	0.4681E 00	0.136569E-02	0.153205E-02	-0.108583E 02
0.426	0.15	61.4000	0.0013106	0.0006329	0.2573E 08	0.4109E 08	0.9760	0.4655E 00	0.139309E-02	0.147637E-02	-0.564077E 01
0.529	0.15	60.0000	0.0012807	0.0006185	0.3195E 08	0.5102E 08	0.9764	0.4632E 00	0.136763E-02	0.142609E-02	-0.409913E 01
0.647	0.14	58.3000	0.0012444	0.0006010	0.3908E 08	0.6241E 08	0.9767	0.4611E 00	0.133445E-02	0.138088E-02	-0.336215E 01
0.765	0.14	57.6000	0.0012295	0.0005938	0.4621E 08	0.7379E 08	0.9770	0.4594E 00	0.132291E-02	0.134435E-02	-0.159501E 01
0.882	0.14	55.5000	0.0011847	0.0005721	0.5327E 08	0.8507E 08	0.9772	0.4580E 00	0.127828E-02	0.131409E-02	-0.272471E 01

Table 8. Statistical Analysis of Turbulent Correlation

Source	Sample Size n	$\overline{L}$	σ	E
Flight Data	97	8.50	8.2	0.56
NOL*	41	-2.00	6.8	0.72
NASA - Langley 11-inch Hypersonic	20	22.30	9.1	1.40
VKF Hypersonic Tunnel B	18	0.62	8.5	1.39
VKF Hypersonic Tunnel C	30	4.20	12.1	1.51
VKF Hypervelocity Tunnel F	64	-7.0	9.4	0.80

*T_w/T_o = 0.11 data not included in calculation.

E, most probable error of the mean, see Eq. (33)

σ, standard deviation, see Eq. (32)

$\overline{L}$, mean of a group, see Eq. (31)

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APPENDIX A
CORRELATION PROGRAM

(U) The data reduction program was written for the correlation analysis discussed in Section 4.0. The program was written in single-precision format for an IBM 360 machine in FORTRAN IV language. The program is simplified by using several empirical relationships to arrive at altitude atmospheric properties and inviscid boundary-layer-edge conditions for conical sharp nosed bodies at zero angle of attack. The program is a simple data manipulation and computation time is very short.

3.1 INPUT REQUIRED

(U) For flight data, information required includes altitude, velocity, wall temperature, cone angle, vehicle length, instrumentation location, boundary-layer regime, and one of either absolute surface heating rate, free-stream Stanton number, or edge adiabatic wall Stanton number. Ground facility results must have additional information as to free-stream temperature, pressure, Reynolds number, and Mach number. Tunnel data do not require values for altitude and velocity. Parameter names, units, and input format are included in the program listing. Data sets for different flight altitudes (or facility test conditions) may be stacked by placing a blank card between each set of data.

3.2 EMPIRICAL TECHNIQUES AND LIMITATIONS OF THE PROGRAM

(U) The two basic assumptions in the present method are that free-stream conditions for flight results can be assumed to be approximated by the 1962 Standard Atmosphere and that local inviscid boundary-layer-edge conditions can be calculated from inviscid supersonic relationships for sharp nosed conical bodies at zero incidence. For both of these relationships, empirical equations were developed for the range of altitudes and velocities of interest and for the cone angles and free-stream Mach numbers for which data were available. Further restrictions are placed on the present method by using perfect gas and viscosity relationships which are applicable only to air. Any additional analysis should carefully consider these limitations.

(U) Free-stream parameters as calculated from the present empirical method, the 1962 Standard Atmosphere, and those derived from sounding rocket measurements conducted concurrently with the Reentry F flight (Ref. 2) are shown in Fig. A-1. Values of Mach and Reynolds numbers were calculated from the measured Reentry F trajectory velocities. Comparison is very good over the desired altitude range and could be used at even higher altitudes with only small errors. No calculations were performed at altitudes less than 40,000 ft. If used below this altitude, similar comparisons should be made.

(U) Solutions for the sharp cone, conical shock, inviscid edge conditions published in tabular form by Jones (Ref. 10) were used to derive a set of empirical closed form equations to cover the range dictated by the available experimental data. Comparison of edge properties as a function of cone half angle θ_c are shown in Fig. A-2 compared to exact solutions. Since edge properties are also a function of free-stream Mach number (for a given θ_c), the parameters were computed for constant values of Mach number and different values were used in each part of Fig. A-2 to demonstrate the accuracy of the present empirical equations. The range of Mach number and cone half-angle shown in Fig. A-2 is considerably greater than the present data represent. Also shown are typical Reentry F flight values for each parameter. These illustrate the present difficulty for true ground test simulation. For instance, in Fig. A-2a, it is seen that local edge Mach number could be simulated on a 5-deg model at a free-stream Mach number of about 18 or 20. However, turbulent boundary layers can not normally be produced at these high values. In order to simulate local surface Reynolds numbers, compromises in cone angle and Mach number are necessary. The results of this study indicate, at least in the present case, that this does not introduce large errors in the simulation.

(U) The results shown in Fig. A-2 are in very good agreement with the exact solutions except at high cone angle, Mach number combinations where small errors are obvious. It is believed that the present empirical solutions are accurate to a few percent in the range

$$4 \lesssim M_\infty \lesssim 20$$

$$3 \lesssim \theta_c \lesssim 30 \text{ deg}$$

(U) Applications outside of this range should be checked against exact solutions of the required inviscid edge conditions.

3.3 PROGRAM LISTING

MAIN

```
      IMPLICIT REAL(A-H,O-Z)
      DIMENSION APRINT (10)
      REAL*8 APRINT
      REAL MINF,ME,ME1
C
C
C        ************************************************************
C
C                             INPUT INFORMATION
C
C          CARD 1 - HEADER CARD -  IDENTIFICATION MESSAGE - FORMAT, 20A8
C          CARD 2 - ALTITUDE, FT. - VELOCITY,FPS - WALL TEMP.,DEG. R - CONE HALF
C     *    ANGLE, DEG. - CONE TOTAL SHARP LENGTH, FT. - FORMAT, 5F10.0
C          NOTE -  FOR TUNNEL DATA ENTER ALT. AND VEL. AS 1.0
C          CARD 3 - FREESTREAM TEMP., DEG. R - FREESTREAM PRESSURE, PSF
C     *    FREESTREAM REYNOLDS BASED ON CONE SHARP LENGTH - FREESTREAM MACH
C     *    NUMBER - FORMAT, 4F10.0
C          NOTE - CARD 3 IS NOT REQD. FOR FLIGHT DATA
C          CARD 4,5 ETC.  DATA CARDS - ONE REQD. FOR EACH DATA POINT
C     *    XN EQUALS 0.50 IF DATA PT. IS FOR LAMINAR BOUNDARY LAYER.
C     *    XN IS ANY NUMBER OTHER THAN 0.5 OR 0 IF DATA IS FOR TURB. B.L.
C     *    XL IS SURFACE LOCATION OF DATA PT. AS RATIO TO CONE LENGTH
C     *    QDOT IS SURFACE HEATING RATE IN BTU/FT-SQ. SEC.
C     *    STINF IS FREESTREAM STANTON NUMBER DEFINED IN NOMENCLATURE
C     *    STEAW IS EDGE STANTON NUMBER DEFINED BY EQ. 3
C     *    NOTE -  ONLY ONE OF QDOT, STINF, STEAW IS REQD. -  SET OTHER TWO
C     *    TO THE VALUE 99.9 - FORMAT 5F10.0
C     *    PLACE BLANK CARD BEFORE NEXT HEADER CARD TO STACK CASES
C
C        ***********************************************************
C
    1 READ(5,999,END=100)(APRINT(I),I=1,10)
    2 READ(5,998) ALT,UINF,TW,DTHETA,XLENGT
      THETA = DTHETA*0.017453292S
      WRITE (6,986) (APRINT(I),I=1,10)
   10 IF (ALT-200.) 11,11,12
   11 READ (5,997) TINF,PINF,REILS,MINF
       IF (TINF.LE.180.00) GO TO 3
C
C          VISCOSITY LAWS GIVEN BY EQ. 27
C
      VIS1 = (2.27E-08 * TINF**1.5) / (TINF + 198.6)
      GO TO 13
    3 VIS1 = 0.0809E-08*TINF
      GO TO 13
C
C          THIS SECTION CALCULATES ATMOSPHERIC CONDITIONS MATCHING 62 STD. ATM.
C
   12 PZI = ((ALT - 92500.)/250. + 90.)*0.01745329?5
      XDELTA = 1.0 + 0.018*COSF(PZI)
      TINF = 1.8*XDELTA*(297.8 - 0.0031134 * ALT + 3.292E-08*ALT**2
     1 -6.1964E-14*ALT**3 -3.2794E-19 * ALT**4 + 8.83165E-25*ALT**5 )
      A1 = -7.257099E-05
      A2 = 1.9579591E-09
      A3 = -2.7538499E-14
      A4 = 2.2830936E-19
```

MAIN

```
              AS = -I.1S69S1E-24
              A6 = 3.5160879E-30
              A7 = -S.8778739E-36
              A8 = 4.1S26229E-42
              B1 = -3.S16SS78E-0S
              B2 = -I.7688797E-10
              B3 = 2.3472039E-14
              B4 = -9.1762251E-19
              BS = 1.7985068E-23
              B6 = -I.7736033E-28
              B7 = 9.02430S4E-34
              B8 = -1.9I392I0E-39
              B9 = 3.68S3989E-46
              PINF = I4.7*144.*(I.0+A1*ALT+A2*ALT**2+A3*ALT**3+A4*ALT**4+A5
             1 *ALT**5+A6*ALT**6+A7*ALT**7+A8*ALT**8)/(1.0+B1*ALT+B2*ALT**2+B3*
             2 ALT**3+B4*ALT**4+B5*ALT**S+B6*ALT**6+B7*ALT**7+B8*ALT**8+B9*ALT
             3 **9)
              MINF = UINF/SQRTF(I.4*1717.6*TINF)
               IF (TINF.LE.180.00) GO TO 4
              VISI = (2.270E-08*TINF**I.S)/(TINF+I98.6)
              GO TO S
            4 VISI = 0.0809E-08*TINF
      C
      C           REILS IS FREESTREAM REYNOLDS NO. BASED ON TOTAL CONE SLANT LENGTH.
      C
            S REILS   = (PINF*UINF*XLENGT )/(VISI*TINF*1717.6)
           13 XMSIN = MINF*SINF(THETA)
      C
      C           TEINF IS RATIO OF EDGE TO FREESTREAM TEMPERATURES
      C
              TEINF =0.98971+0.20S3S9*XMSIN+0.138168*XMSIN**2+0.0170193*XMSIN**3
             1+0.000190588*XMSIN**4-0.00020729*XMSIN**5
              TEINF = TEINF/(1.0+0.4/MINF**2.S* XMSIN)
              IF (XMSIN-5.S) 66,S5,5S
           S5 TEINF = TEINF*(1.0+(XMSIN-S.S)**2 *0.023S)
           66 CONTINUE
              TE = TEINF*TINF
      C
      C           PWINF IS RATIO OF EDGE TO FREESTREAM PRESSURES, PE EQUALS PWALL
      C
              PWINF = 1.0+1.47*XMSIN**(2.+0.43/(XMSIN**3-1.0))
              PWINF = PWINF/(1.0+0.88/MINF**2.S*XMSIN)
              BRACK = 1.-1./MINF
              XA = BRACK**1.7
              PXA = XMSIN/XA
              XZA = I.002S4
              XZB = -0.1023S3
              XZC = -0.0331366
              XZD = 0.0092311S
              XZE = -0.00081472
              XZF = 0.000244751
      C
      C           RATIO IS THE RATIO OF EDGE TO FREESTREAM MACH NUMBERS
      C
              RATIO = XZA + XZB*PXA+XZC*PXA**2+XZD*PXA**3+XZE*PXA**4+XZF*PXA**5
              ME = RATIO*MINF
```

MAIN

```
0063          ME = ME/(I.0+0.03*SINF(0.8726615*(XMSIN-0.0008*MINF**2))*(SQRTF
             1 (MINF)-3.82))
0064          IF (XMSIN-3.5) 265,266,266
0065      266 ME = ME/(I.0+(XMSIN-3.5)*0.042/MINF)
0066      265 CONTINUE
        C
        C          UEINF IS RATIO OF EOGE TO FREESTREAM VELOCITIES
        C
0067          UEINF = ME*SQRTF(TEINF)/MINF
0068          PE = PWINF*PINF
        C
        C          TOINF IS RATIO OF TOTAL TO FREESTREAM TEMPERATURES FOR PERFECT GAS
        C
0069          TOINF = I.0 + 0.2*MINF**2
0070          TO = TOINF*TINF
0071          IF (TE.LE.I80.00) GO TO 6
0072          VISE = (2.270E-08*TE**I.5)/(TE+198.6)
0073          GO TO 7
0074        6 VISE = 0.0809E-08*TE
        C
        C          REELS IS EOGE REYNOLOS NO. BASEO ON TOTAL CONE SLANT LENGTH
        C
0075        7 REELS = REILS  *(VISI/VISE)*UEINF* PWINF/TEINF
0076          XKK = (49.03**2)/(2.*3.5*I7I7.6)
        C
        C          TSTART IS REF. TEMP. FOR TURB. B.L. OEFINEO BY EQ. 13
        C
0077          TSTART = TE + 0.45*(TW-TE) + 0.I75*XKK*TE*ME**2
0078          IF (TSTART.GT.2000.00) GO TO 8
0079          VISTT   = 2.270E-08*TSTART**I.5 / (TSTART + 198.6)
0080          GO TO 9
0081        8 VISTT = 0.072E-07*TSTART**0.64
        C
        C          TSTARL IS REF. TEMP. FOR LAM. B.L. DEFINEO BY EQ. 9
        C
0082        9 TSTARL = TE + 0.5*(TW-TE) + 0.I85*XKK*TE*ME**2
0083          IF (TSTARL.GT.2000.00) GO TO 9I
0084          VISTL   = 2.270E-08*TSTARL**1.5 / (TSTARL + I98.6)
0085          GO TO 92
0086       9I VISTL = 0.072E-07*TSTARL**0.64
        C
        C          CSTART ANO CSTARL ARE VISCOSITY TERMS OEF. BY EQ. 20 BASEO ON
        C    *     TURB. OR LAM. REF. TEMP.
        C
0087       92 CSTART = VISTT  *TE/(VISE*TSTART)
0088          CSTARL = VISTL  *TE/ ( VISE*TSTARL)
        C
        C          ROURO IS RATIO OF OENSITY TIMES VELOCITY AT EOGE TO THE
        C    *     FREESTREAM VALUES
        C
0089          ROURO = PE*ME*SQRTF(TINF/TE)/(PINF*MINF)
0090          TWTO = TW/TO
009I          OEN1 = 0.22052*PE*ME*(0.843*TO-TW)/SQRTF(TE)
0092          OEN2 = 0.22052*PE*ME*(0.892I1*TO-TW)/SQRTF((TE))
0093          OEN3 = 0.22052*PINF*MINF*(TO-TW)/SQRTF(TINF)
0094          WRITE(6,995) MINF,TINF,TW,TWTO,REILS,OTHETA,XLENGT ,ME,ALT,UINF
```

MAIN

```
                WRITE(6,994) PINF,PWINF,TEINF,UEINF,ROURO,REELS
                WRITE(6,989)
             14 REAO (5,998) XN,XL,QOOT,STINF,STEAW
                IF (XN.EQ.0) GO TO 32
                IF (XN.EQ.0.5000) GO TO 15
      C
      C              REEL IS LOCAL EOGE REYNOLOS NUMBER AT GAGE LOCATION
      C              REELP IS INCOMP. EDGE REYNOLOS NO. AT GAGE LOCATION
      C
                REEL = REELS*XL
                REELP = REEL*TE*VISE/(TSTART*VISTT)
      C
      C              XN IS SKIN FRICTION POWER LAW FOR TURB. B.L. OEF. BY EQ. 17
      C
                XN = (0.868600*ALOG10(REELP)-2.43500)/((ALOG10(REELP)-1.500)*
               1(ALOG10(REELP)-2.36800))
             15 IF (QOOT-99.900) 16,20,16
      C
      C              STINF IS FREESTREAM STANTON NUMBER OEFINEO IN NOMENCLATURE
      C
             16 STINF = QOOT/OEN3
             17 IF (XN.NE.0.500) GO TO 19
      C
      C              STEAW IS EOGE STANTON NUMBER DEF. BY EQ. 3
      C
             18 STEAW = QDOT/OEN1
                GO TO 28
             19 STEAW = QOOT/DEN2
                GO TO 28
             20 IF (STINF.GT.99.000) GO TO 22
             21 QOOT = STINF*DEN3
                GO TO 17
             22 IF (STEAW.GT.99.000) GO TO 27
             23 IF (XN.EQ.0.500) GO TO 25
             24 QOOT = OEN2*STEAW
                GO TO 26
             25 QDOT = OEN1*STEAW
             26 STINF = QOOT / DEN3
                GO TO 28
             27 WRITE (6,996)
                GO TO 14
      C
      C              REINFL IS FREESTREAM REYNOLOS NUMBER AT GAGE LOCATION
      C
             28 REINFL= REILS*XL
      C
      C              REEL IS EDGE REYNOLOS NUMBER AT GAGE LOCATION
      C
                REEL =  REINFL*(VISI/VISE)*UEINF*PWINF/TEINF
                IF (XN-0.5000) 30,29,30
      C
      C              CST2N IS VISCOSITY TERM OEF. BY EQ. 20 RAISED TO THE XN POWER
      C
             29 CST2N = CSTARL**0.5
      C
      C              TEP IS OEF. BY EQ. 25 FOR LAM. B.L. ANO EQ. 26 FOR TURB. B.L.
```

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MAIN

```
                C
0126                  TEP = 0.76100/REEL**XN
0127                  GO TO 31
0128               30 CST2N = CSTART**XN
0129                  TEP = 0.024400/REEL**0.16000
                C
                C          ROSROE IS RATIO OF OENSITY AT REF. TEMP. TO OENSITY AT EOGE TEMP.
                C
0130               31 ROSROE = (TE/TSTART)**(1.-2.*XN)
                C
                C          EP IS CORRELATION PARAMETER FOR OATA OEF. BY EQ. 23
                C
0131                  EP = STEAW/(CST2N*ROSROE)
                C
                C          PE IS PERCENT DIFFERENCE BETWEEN EP ANO EQ. 25 OR 26
                C
0132                  PE = (EP-TEP)*100.00/TEP
0133                  WRITE (6,990) XL,XN,QOOT,STINF,STEAW,REINFL,REEL,CST2N,
                     1 ROSROE,EP,TEP,PE
0134                  GO TO 14
0135               32 GO TO 1
                C
                C
                C         **************************************************************
                C
                C          OUTPUT INFORMATION
                C
                C          MINF IS FREESTREAM MACH NUMBER
                C          TINF IS FREESTREAM TEMP. IN OEG. R
                C          TW IS WALL TEMP IN OEG. R
                C          TW/TO IS RATIO OF TW TO STAG. TEMP.
                C          REINFLS IS FREESTREAM REYNOLOS NO. BASED ON TOTAL CONE LENGTH
                C          THETA IS CONE HALF ANGLE IN OEGREES
                C          LS IS CONE TOTAL SLANT LENGTH IN FEET
                C          ME IS EDGE MACH NUMBER
                C          ALT. IS ALTITUOE IN FEET. - NOTE -  IF ALT. IS  1 OATA ARE FOR
                C     *    GROUNO FACILITIES
                C          UINF IS FREESTREAM VELOCITY - SEE NOTE ABOVE
                C          PINF IS FREESTREAM PRESSURE IN PSF
                C          PE/PINF IS RATIO OF EOGE TO FREESTREAM PRESSURE
                C          TE/TINF IS RATIO OF EOGE TO FREESTREAM TEMPERATURES
                C          UE/UINF IS RATIO OF EOGE TO FREESTREAM VELOCITIES
                C          ROUE/ROUINF IS RATIO OF OENSITY TIMES VEL. AT EOGE TO F.S. VALUE
                C          REELS IS EOGE REYNOLOS NUMBER BASEO ON CONE TOTAL SLANT LENGTH
                C          X/L IS GAGE OR THERMOCOUPLE LOCATION
                C          N IS 0.5 FOR LAM. B.L. ANO SOLUTION OF EQ. 17 FOR TURB. B.L.
                C          QDOT IS LOCAL HEATING RATE IN BTU/FT-SQ. SEC
                C          STINF IS FREESTREAM STANTON NUMBER
                C          STEAW IS EOGE STANTON NUMBER
                C          REINFL IS FREESTREAM REYNOLOS NO. AT X/L


                C          REEL IS EOGE REYNOLOS NUMBER AT X/L
                C          CSTAREN IS SOLUTION OF EQ. 20 RAISEO TO THE N POWER
                C          ROSTROE IS THE RATIO OF EOGE OENSITY TO FREESTREAM VALUE ALL
```

MAIN

```
     C     *     RAISED TO THE 1 - 2N POWER
     C           EDGE PARAMETER IS SOLUTION OF EQ. 23 FOR DATA PT. IN QUESTION
     C           T.E.P. IS SOLUTION OF EQ. 25 OR 24 AT REEL
     C           P.E. IS THE PERCENT DIFFERENCE BETWEEN EDGE PARA AND T.E.P.
     C
     C           ****************************************************************
0137       999 FORMAT (20A8)
0138       998 FORMAT (5F10.0)
0139       997 FORMAT (4F10.0)
0140       996 FORMAT (1H0,23HINSUFFICIENT DATA INPUT    )
0141       995 FORMAT (1H0,4X,4HMINF,5X,7HTINF(R),7X,5HTW(R),9X,5HTW/TO,5X,
              1  7HREINFLS,4X,10HTHETA(DEG),5X,6HLS(FT),7X,2HME,6X,7HALT(FT),5X,
              2 13HUINF(FT/SEC)   / 10E12.4/)
0142       994 FORMAT (1H0,21X,9HPINF(PSF),4X,7HPE/PINF,5X,7HTE/TINF,5X,7HUE/UINF
              1,3X,11HRDUE/RDUINF,3X,5HREELS/20X,6E12.4/
              2 //50X,17HEXPERIMENTAL DATA    )
0143       990 FORMAT (1H ,F6.3,F5.2,F8.4,2F10.7,2E12.4,F8.4, E12.4,3E14.6)
0144       989 FORMAT (1H0,3X,3HX/L,2X,1HN,5X,4HQDDT,4X,5HSTINF,6X,5HSTEAW,4X,
              1 6HREINFL,7X,4HREEL,5X,7HCSTAREN,3X,7HRDSTRDE,7X,9HEDGE PARA,7X,
              1 6HT.E.P.,8X,4HP.E. )
0145       987 FORMAT (1H ,30X,6E12.4   )
0146       986 FORMAT (1H1,20A8)
     C
     C
0147       100 CONTINUE
0148           END
```

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3.4 OUTPUT

(U) Typical program output is shown in Tables 1, 3, 4, and 7. The program reads one of the three parameters q, St_∞, $St_{e,aw}$, and computes the other two. The names REINFL and REEL are misnomers and should have been named REINFX and REEX to be consistent with the normal nomenclature and data plots. The parameter P.E. should be considered a percent difference rather than a percent error since no claim is made herein as to the overall accuracy of the correlation parameters.

(U) Parameter names of program output are defined as follows:

ALT	Altitude in feet; if ALT is unity, data are from a ground facility.
CSTAREN	Solution of Eq. (20) raised to the N power
EDGE PARA	Solution of Eq. (23) for data point in question
LS	Cone total slant length in feet
MINF	Free-stream Mach number
ME	Edge Mach number

N	Slope of skin friction law - 0.5 for laminar boundary-layer Solution of Eq. (17) for turbulent boundary layer
PINF	Free-stream pressure in PSF
P.E.	Percent difference between edge parameter and T.E.P.
PE/PINF	Ratio of edge to free-stream pressure
QDOT	Local heating rate in Btu/ft^2 sec
REEL	Edge Reynolds number at X/L
REELS	Edge Reynolds number based on total cone slant length
REINFL	Free-stream Reynolds number at X/L
REINFLS	Free-stream Reynolds number based on total cone slant length
ROSTROE	Ratio of the edge density to free-stream value raised to the (1 - 2N) power
ROUE/ ROUINF	Ratio of density times velocity at edge of boundary layer to free-stream values
STEAW	Edge Stanton number
STINF	Free-stream Stanton number
TE/TINF	Ratio of edge to free-stream temperature
TINF	Free-stream temperature in °R
TW	Wall temperature in °R
TW/TO	Ratio of wall to stagnation temperature
THETA	Cone half-angle in degrees
T.E.P.	Solution of Eq. (25) or (26) at REEL

UE/UINF	Ratio of edge to free-stream velocities
UINF	Free-stream velocity
X/L	Gage or thermocouple location

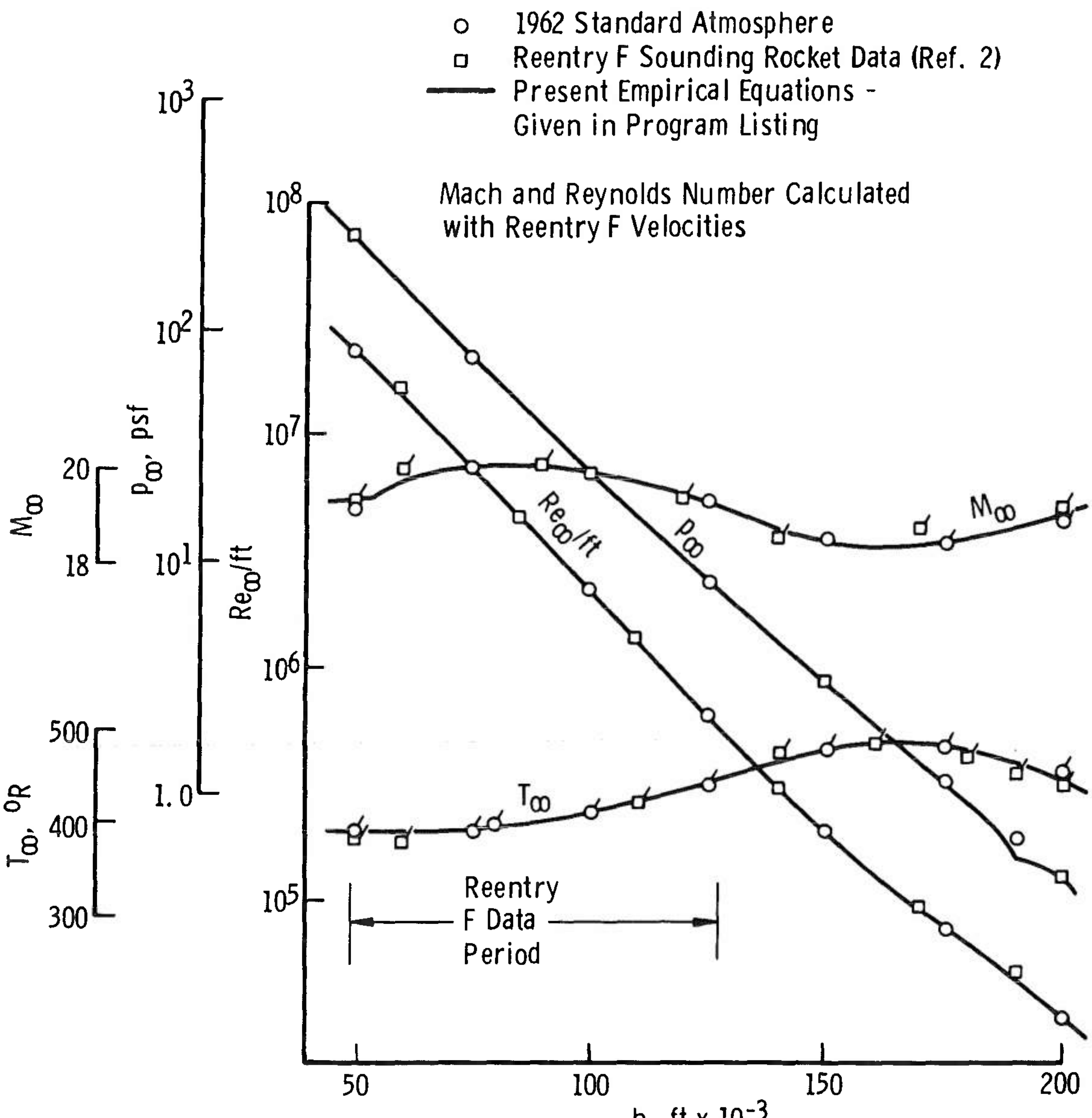
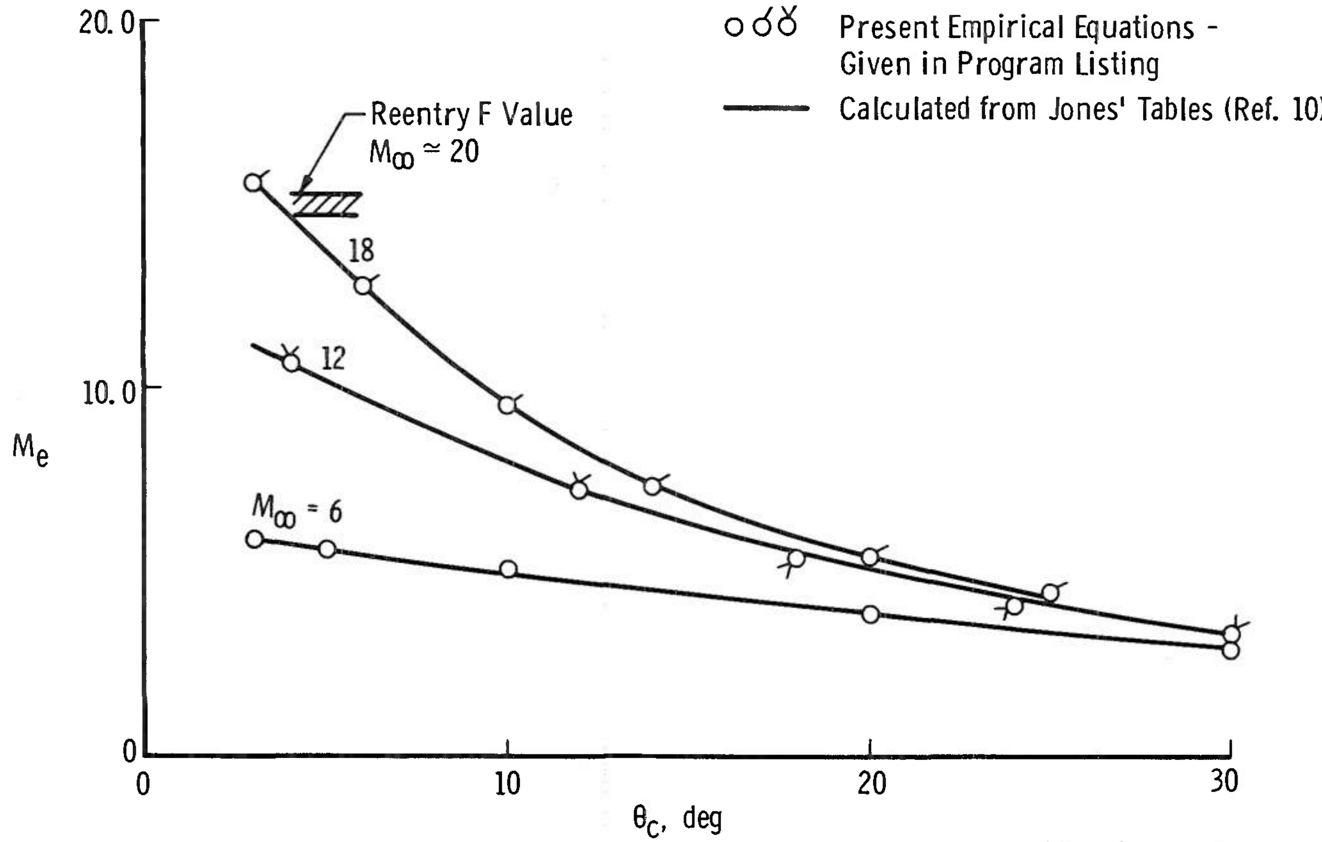
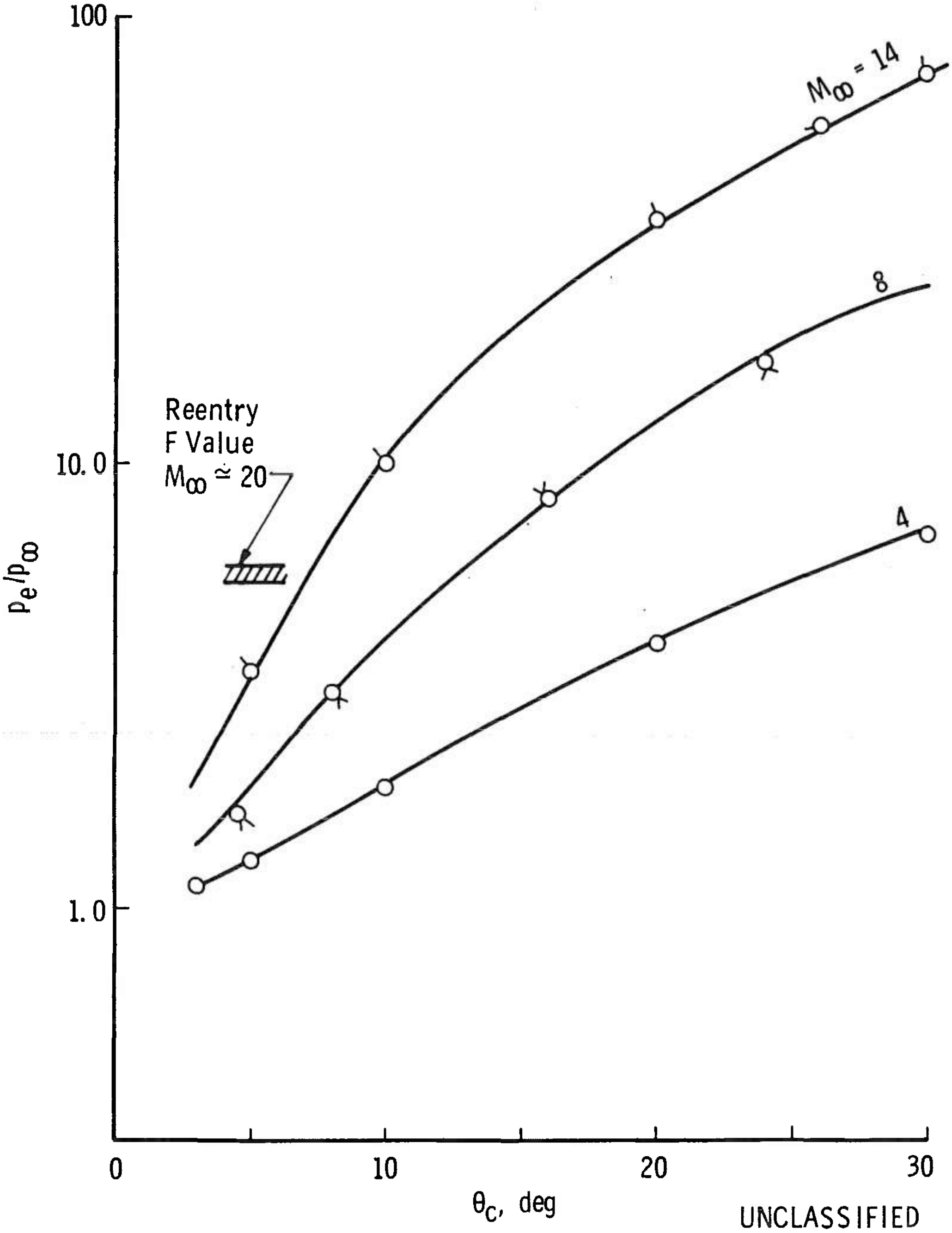


Figure A-1. Comparison of empirical solutions of atmospheric properties to 1962 standard atmosphere and Reentry F values.

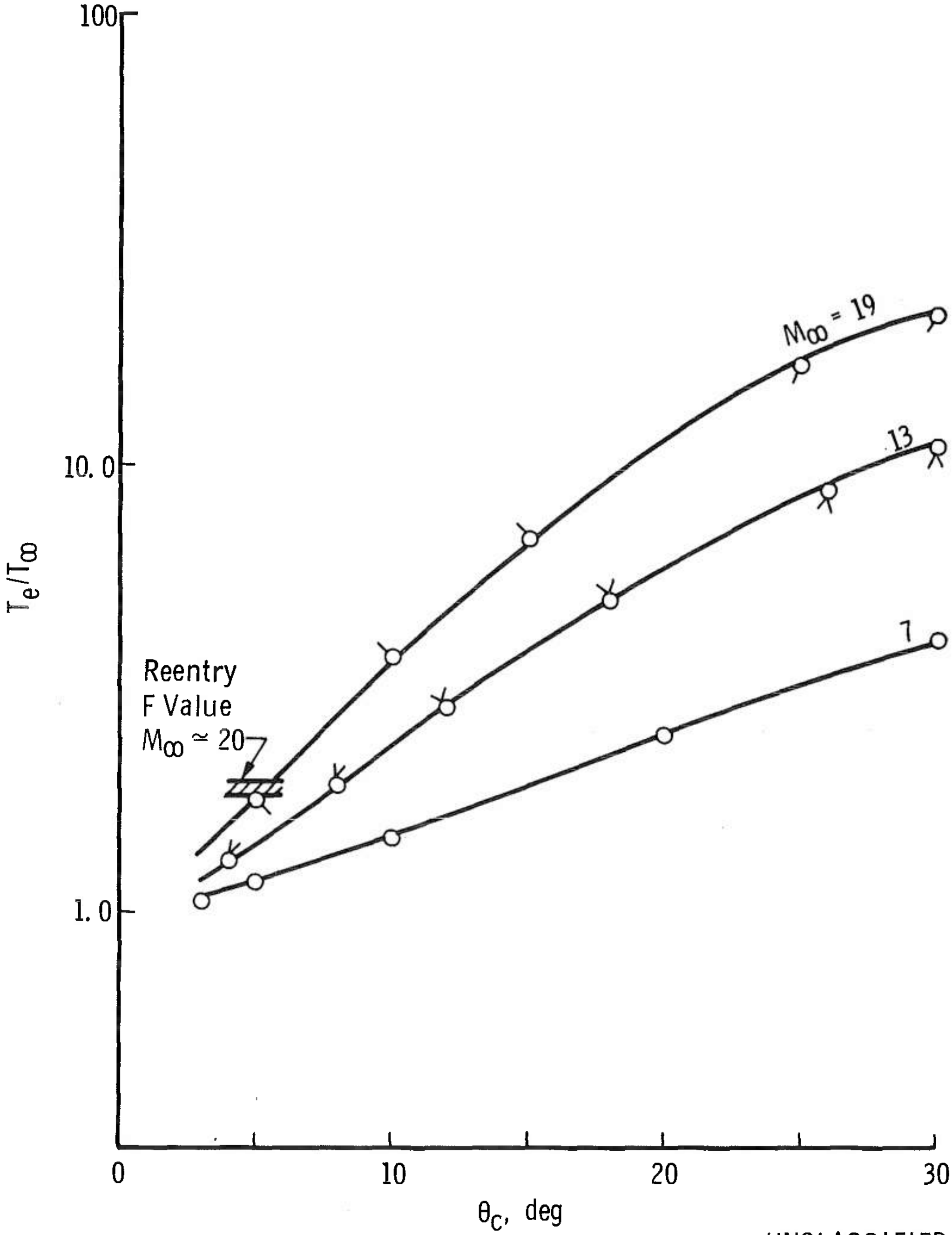


a. Edge Mach number

Figure A-2. Comparison of empirical inviscid conical edge conditions to exact solutions.



b. Edge pressure
Figure A-2. Continued.



c. Edge temperature
Figure A-2. Continued.

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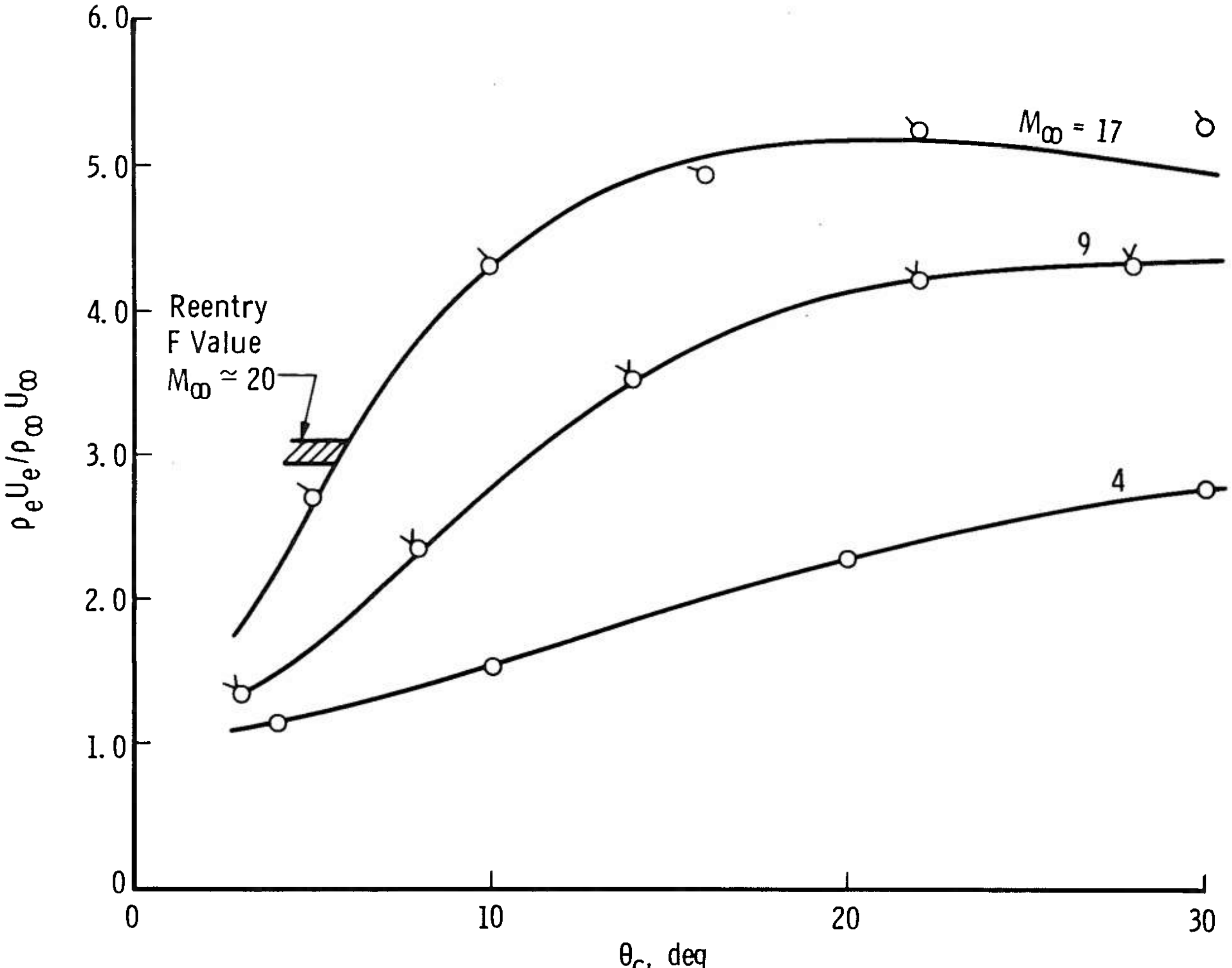

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d. Edge ρU
Figure A-2. Continued.

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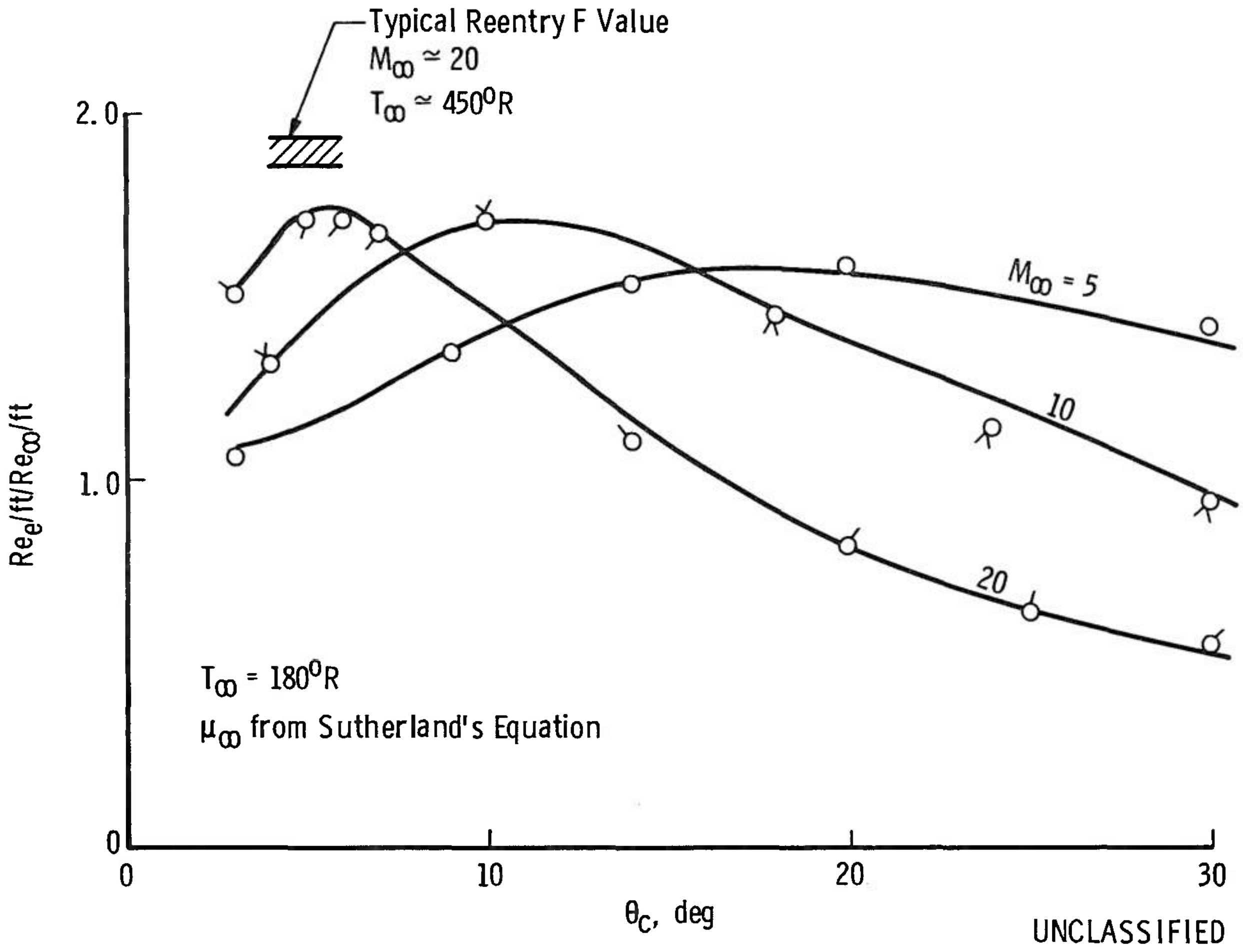

e. Edge Reynolds number
Figure A-2. Concluded.

NOMENCLATURE

C_e^*	Chapman-Rubesin linear viscosity relationship defined by Eq. (20)
C_f	Coefficient of local skin friction
E	Most probable error of the mean defined by Eq. (33)
H	Enthalpy
h	Altitude or static enthalpy
K_1	Constant in Eq. (22) or (23)
K'	The constant $\sqrt{3}K_1/2Pr^{2/3}$
$\overline{L}$	Mean of the parameter L_i of sample size n
L_i	Parameter defined by Eq. (30)
L_s	Sharp cone total slant length
M	Mach number
n	Exponent of skin friction law (Eq. (1) and (16) or sample size
Pr	Prandtl number
$\dot{q}$	Heat-transfer rate, Btu/ft^2-sec
R	Gas constant for air taken as 1717.6 ft^2/sec^2 °R
Re	Reynolds number (see Eq. (15) for definition of incompressible Reynolds number)
r_b	Base radius
r_f	Recovery factor
r_n	Nose radius
St_∞	Free-stream Stanton number defined as $\dot{q}/\rho_\infty U_\infty(H_o - h_w)$
St_e	Stanton number based on inviscid edge conditions and adiabatic wall enthalpy, $\dot{q}/\rho_e U_e(H_{aw} - h_w)$

T	Temperature
t	Time
U	Velocity
x	Surface distance from nose of sharp cone measured along cone slant length to instrumentation location
α	Angle of attack
γ	Ratio of specific heats
ϵ_{RMS}	Root mean square error defined by Eq. (34)
θ_c	Cone half angle, deg
μ	Viscosity defined by Eq. (29)
ρ	Density
σ	Standard deviation
ϕ	Model ray (Fig. 1)

SUBSCRIPTS

∞	Free-stream conditions
aw	Adiabatic wall
c	Calculated by Eq. (25) or (26), see Eq. (30)
e	Conditions at edge of the boundary layer
m	Evaluated using measured $\dot{q}$, see Eq. (30)
o	Stagnation conditions
r	Reference conditions
w	Wall conditions
x	Cone slant length to gage location
α	At angle of attack

SUPERSCRIPTS

*	Evaluated at reference temperature T*
'	Indicates incompressible value

Computer nomenclature is given in Appendix A.